ontario hydro

PROPOSED GENERATING STATION B FOR PICKERING

proposed generating station for Pickering April 1974

PROPOSED GENERATING STATION FOR PICKERING

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APPENDICES

PROPOSED GENERATING STATION FOR PICKERING

1.0 INTRODUCTION

The growing demand for electrical power in Ontario supports the early commitment of a new generating station to meet the needs of the East System in 1980. This document examines some of the key issues of this situation and proposes that an additional nuclear generating station be constructed at Pickering.

This is a final proposal which Ontario Hydro is submitting for approval by the Government. Ontario Hydro has solicited views from the public and the responsible Ministries within the Government. A report on the public participation program and review with the various Ministries forms part of this final proposal.

A companion document entitled "Environmental Assessment" comments on the anticipated environmental effects of building and operating this nuclear generating station on the Pickering site. It concludes that such effects are acceptable.

The Pickering site at present accommodates a nuclear generating station consisting of four units designated Units 1 to 4. The proposed additional generating station will consist of four units designated Units 5 to 8.

2.0 SUMMARY

A long range program to meet the Province's load growth was tabled in the Ontario Legislature in June 1973. The program included the fossil plant at Wesleyville, nuclear plants at Pickering, Bruce and Bowmanville, extensions to Thunder Bay and to the Bruce Heavy Water Plant. This proposal covers the new generation required for 1980 through 1982.

It is proposed that this growth be provided by the construction of a 2160 MW nuclear station. Construction is scheduled to start in May 1974 with one unit coming into service in 1980, two in 1981, and one in 1982, at an estimated capital cost of $1,266,000,000 in 1982 dollars. The station design will be similar to that of the existing nuclear station at the Pickering site.

The preliminary proposal was submitted in November 1973 and distributed to the following:

a) Ministry of the Environment
Ministry of Natural Resources
Ministry of Agriculture and Food
Ministry of Health
Ministry of Transportation and Communications
Ministry of Treasury, Economics and Intergovernmental Affairs

b) Municipalities in the project vicinity

c) General public

Meetings have been held with the public, municipalities concerned, and with the Ministries as required.

From Ontario Hydro's assessment, there appears to be general acceptance of the proposed plant by the public.

Also from Ontario Hydro's assessment, the expansion of information presented in our proposal appears to have satisfied the various Ministries, in particular, the Ministry of Natural Resources and the Ministry of the Environment. Further information will be developed during the detailed design phase and these designs will be individually submitted for Ministry approval.

2.1 ALTERNATIVES

The alternative to this project is NO GENERATION.

This would result in reduced system reserve and hence reduced reliability of the power supply unless there is:

a) Voluntary reduction of demand by customers

b) Government control of electrical use.

Alternatives which will not meet the system requirements:

(1) Coal fire generation

Would allow no margin for meeting more stringent emission standards and cannot be built in time to meet the 1980 requirements.

(2) Oil fire generation

There are uncertainties surrounding the future supply and cost of oil. These problems enhance the relative position of nuclear generation and make it attractive for this particular generation requirement.

2.2 APPROVAL REQUESTED

Approval is requested for the construction and operation of a 2160 MW nuclear generating station at Pickering with the first unit in-service date of 1980.

A decision is required no later than April 1, 1974 in order to meet the in-service date.

3.0 THE NEED FOR NEW GENERATION

The main pressure for developing additional generation arises from the growth in electrical load. A secondary factor is the degree of reliability with which the power is to be supplied, and the amount of reserve generation needed to meet the reliability target. This in turn is dependent upon the capability of the operators and apparatus to accommodate a spectrum of contingencies without causing any loss of electrical service to Ontario Hydro's customers.

3.1 FORECAST OF LOAD GROWTH

Generally speaking, Ontario Hydro electrical load has grown in a climate of plenty. There has been space for the growing population plus immigration from abroad and other provinces. The economy has grown to support the population and to raise the standard of living. Supplies to Ontario Hydro of capital funds and raw materials have been adequate; and the environmental constraints which have always existed to some degree have not prevented Ontario Hydro from fully supplying all load growth.

In that climate, Ontario Hydro's power and energy loads have grown substantially. Although there have been wide year-to-year variations in growth, the long-term pattern has been exponential and roughly equivalent to a constant value of 7% per annum on both the East and West Systems. This has led to a doubling in load approximately every 10 years. Of the 7% per annum growth, roughly 2% was due to population growth and 5% due to increased per capita consumption.

The projecting future growth over the long term, major uncertainties exist. It seems probable that population growth will eventually decline, and that the growth in electrical load will also eventually decline. However, in the short-term period up to 1982, it is estimated that the average growth will continue at 7% per annum in the East System.

The load forecast for the East System indicates a load of 21,026 MW in 1980, 22,497 MW in 1981 and 24,072 MW in 1982.

3.2 RELIABILITY OF ELECTRICAL SUPPLY

3.2.1 Components of Reliability

The overall electrical supply system can be conveniently separated into three functions: generation, bulk transmission, and distribution.

The reliability of the system is determined by two factors:

(i) The availability of its components, i.e., whether a sufficient number of components is available to supply the load, as compared to being out of service due to breakdown, scheduled maintenance, etc., and,

(ii) The security of its components, i.e., whether the components that are available have the ability to withstand sudden shocks due to breakdown or malfunction of equipment, natural phenomena (such as lightning), operating error, etc.

The major factors in overall reliability are the availability of the generation, and the security of the bulk transmission.

3.2.2 Factors Affecting Reliability

Some factors affecting the reliability of the components of bulk electrical supply are:

(a) Generating units and bulk transmission systems are not 100% dependable and breakdowns will occur. The extent of these breakdowns on generating units is affected by the sizes of the individual units, their type (fossil-fuelled or nuclear thermal, hydraulic, etc.), their design, the quality of their components, and the pattern to which they are operated.

(b) Equipment cannot run continuously. To reduce the number and effect of breakdowns, equipment must be taken out of service to enable preventative maintenance to be done.

(c) Equipment is subject to failure or reduction in output when subjected to adverse weather conditions such as extreme heat, cold, wind, ice, high or low river flows to hydraulic plants, etc.

(d) Strikes of staff.

(e) Failure of supplies of critical operating materials, eg., coal, oil gas, heavy water, nuclear fuel, etc.

(f) Failure to bring new generation and transmission facilities into service on schedule.

(g) Failure of Hydro-Quebec, Manitoba Hydro or other utilities to deliver firm power as contracted.

(h) Unanticipated changes in governmental policies, regulations, or guidelines, which may reduce Ontario Hydro's freedom to use its facilities as designed, or which may require plant to be kept out of service in order that it can be rebuilt or improved.

(i) Errors in operating and maintaining equipment.

(j) Unavailability of staff and facilities within Ontario Hydro and among manufacturers for effecting maintenance and repairs.

The reliability of the Ontario Hydro East System is also affected by the extent to which it can obtain assistance from neighbouring systems. Difficulties in obtaining approvals for new generation and transmission are being experienced by the systems in the United States. It seems likely that in the period 1977-1982, they will be short of reserve capacity and transmission, and their assistance should not be relied upon as a means for reducing Ontario Hydro generation. Joint studies of reserve savings have been made by Ontario Hydro and Hydro-Quebec; but their conclusion was that they were not practicable in the period up to 1980.

3.2.3 Future Reliability of Electrical Supply

It is assumed that the current high level of reliability must be maintained in the future, for it is critical to most industrial, commercial, and rural customers, and highly desired by residential customers.

To maintain this level of reliability in the period 1977-1982, the reserve generating capacity as a percent of the load should be about 27% of the East System.

3.3 ADDITIONAL GENERATION REQUIRED

Generation committed under the present program is expected to meet the forecast loads in the East System until the end of 1978 with adequate reliability; but in 1979 and 1980, it provides the following relationship between capacity and load:

		1979	1980
1.	Capacity under the committed program	23700 MW	23700 MW
2.	Forecast load	19556 MW	21026 MW
3.	Reserve capacity (1-2)	4144 MW	2674 MW
4.	Reserve capacity as a percent of load	21%	13%

The reserve capacity is inadequate in 1979 and 1980. Under the proposal to bring two 538 MW units into service at Wesleyville in each of the years 1979 and 1980, the following relationship would apply:

1.	Capacity proposed	24776 MW	25852 MW
2.	Forecast load	19556 MW	21026 MW
3.	Reserve capacity (1-2)	5220 MW	4826 MW
4.	Reserve capacity as a percent of load	27%	23%

Thus, the Wesleyville proposal meets the reserve requirement in 1979, but it does not meet the requirement in 1980. Further new capacity will be required to be brought into service in 1980 at another site.

Under the proposal to bring one 514 MW unit into service at Pickering in 1980, followed by two units in 1981 and one unit in 1982 the following relationship would apply:

		1980	1981	1982
1.	Capacity proposed	26366 MW	27394 MW	27908 MW
2.	Forecast load	21026 MW	22497 MW	24072 MW
3.	Reserve capacity (1-2)	5340 MW	4897 MW	3836 MW
4.	Reserve capacity as a percent of load	25.5%	22%	16%

Thus the Pickering proposal meets the approximate reserve requirement in 1980 but it does not meet the requirement in 1981 and 1982. Further new capacity will be required to be brought into service in 1981 and 1982 at another site.

4.0 THE CONSIDERATION OF ALTERNATIVES

In determining a course of action for any system as complex as electrical supply, a large number of alternatives must be evaluated. Some of the more important of these are discussed below.

4.1 THE ALTERNATIVE OF NOT PROVIDING GENERATION

Short of a major catastrophe or an economic depression, the load forecast for the period up to 1980 could probably only be reduced by the voluntary action of customers or by government control. There is a high probability that the load will occur, and therefore, failure to bring the proposed plant into service in 1980 would substantially reduce the system reserve. This would cause a marked decrease in the reliability of supply, therefore, it is recommended that the proposed generation be committed for first in-service in 1980.

4.2 ALTERNATIVE SOURCES OF ADDITIONAL GENERATION 1977-1982

(a) Purchases

Further purchases of firm power from Quebec, Manitoba and Saskatchewan are under recurring review. At present for the period 1977-1982, purchases from Quebec seem unlikely. Purchases from Manitoba and Saskatchewan are not practicable at present for the East System but are being examined for the West System.

(b) Hydraulic Capacity

The remaining undeveloped hydraulic capacity in Ontario is either small in terms of its energy-producing content, or it is located at large distances from existing load centres. The few sites which may be economic for development in the period 1977-1982 will not substantially affect the need for new fossil-fuelled and nuclear capacity on either the East or West Systems.

(c) Pumped Storage

Some potential pumped storage projects are available but these will not be economic until a large additional amount of nuclear capacity is developed.

(d) Combustion Turbines

These units are relatively new on the market and have suffered from poor operating availability, but there are indications that their reliability is improving. They require premium fuels and are not economic for generating large blocks of energy.

In the period 1977-1982, some units may be usefully installed on the West System; but they do not appear desirable for installation on the East System except as a stop-gap.

(e) Conventional Fossil Generation

Since 1960, fossil-fired plant has been the primary means of meeting load growth in the absence of further large water power developments. Reliability has been a continuing problem, but constant effort and development have brought it to an acceptable level. However, there are great uncertainties surrounding the future supply and cost of acceptable fossil fuel, and also many difficulties impeding the development of practical commercial methods for treating either the fuel or flue gas to reduce noxious emissions to the atmosphere. These problems enhance the relative position of nuclear generation and make it the

favoured alternative for the future. Because of its lower capital cost and higher operating cost, fossil generation is more economic than nuclear at low capacity factors, but less economic than nuclear at moderate and high capacity factors.

(f) Nuclear Generation

Because of lower fuelling costs, CANDU nuclear generation is more economic than fossil at moderate and high capacity factors, even though its capital cost is higher. Nuclear generation appears more acceptable to the public from an environmental point of view. The price and security of supply of nuclear fuel is considerably more stable than that of fossil fuel.

The reliable production of heavy water needed by the CANDU reactor is vital for predicting the in-service dates of nuclear units. At present, there is a considerable effort to bring operating heavy water plants up to full production and approvals are being sought for additional heavy water plants. It is believed that heavy water will be available in the quantities required for the nuclear generating units covered in this proposal.

In considering the problems associated with both types of generation, those of nuclear generation appear to be considerably less difficult to solve. Accordingly, it is expected that nuclear generation will comprise the major share of Ontario Hydro's future generating plant.

Proposal

In view of our confidence in adequate heavy water supply and the economic advantage for this high capacity factor station, together with our belief that nuclear generation appears more acceptable to the public with regard to environmental considerations, nuclear generation is proposed to meet the 1980 forecast needs.

4.3 ALTERNATIVES FOR STATION LOCATION

The generating station must be located on a site already owned by Ontario Hydro and should be situated close to the load it will serve.

Ontario Hydro owns four sites in this area:

Pickering site, east of Toronto;
Lennox site, west of Kingston;
Wesleyville site, west of Port Hope;
Bowmanville site, west of Bowmanville.

Each site is capable of accommodating two generating stations. A 2152 MW oil-fired station is currently under construction at the Lennox site and the first unit is scheduled for commercial service in June 1975. A 2152 MW oil-fired station is currently proposed for the Wesleyville site and the first unit is scheduled for commercial service in April 1979.

Continuing environmental studies have been carried out on each of these sites, to establish their capability to accept specific types and sizes of generating stations.

In the case of the Bowmanville site, a period of one year or more is required for site grading prior to any construction activity. This extends the schedule and will not permit the commitment of this generation station for 1980 in-service.

The Pickering site was acquired for an eight-unit installation and the engineering and construction experience on the first four units enables us to predict the schedule with a high

degree of confidence and place reliance on having the first unit in service in April 1980. We can use existing field expertise and construction facilities and existing design expertise and manpower requirements will be reduced. The first four units will have accumulated about 5 reactor years' experience by the end of 1973 and this operating experience which we are gathering will allow us to introduce improvements in areas of high cost or concern. It is less economic to repeat Pickering design on a new site because of the economy of duplication on the same site.

The environmental assessment for Pickering indicates that the station can be located on this site without significant harm to the environment.

Proposal

It is proposed that the station be sited at Pickering.

5.0 PROJECT CAPITAL COSTS

An estimate of station capital cost is given in both 1973 and 1982 dollars. 1982 is the first year that the entire station is scheduled for service. The 1973 figures are for a hypothetical station that is built and operated at 1973 costs, and are provided for reference to current costs.

	1973 Dollars	1982 Dollars
Station capital cost	884,000,000	1,239,000,000
Total installed kilowatts	2,056,000	2,056,000
Dollars per installed kilowatt	430	603

ENVIRONMENTAL ASSESSMENT
PROPOSED GENERATING STATION
FOR
PICKERING

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1.0 INTRODUCTION

This document describes and assesses the existing environ- ment and the environmental influences which would occur due to the construction and operation of an additional nuclear generating station, consisting of four 508 MWe units, on the Pickering site. This proposed station, Pickeirng G.S.-B (Units 5-8), is essentially a duplicate of the present station, Pickering G.S.-A (Units 1-4). The proposed station will be designed, constructed and operated using proven technology and with the most up-to-date safety features to minimize the environmental impact. Duplication of an existing station will allow early evaluation of environmental concerns and will ensure minimal environmental effects.

The views of the regulatory authorities and response from the public may influence the factors considered in this document.

2.0 SUMMARY

2.1 AIR

Existing conventional air quality is good due to the absence of any large emissions from industry in the area. Gas turbines now on the site are used infrequently for peak power requirements and emergency internal uses, their contribution to present ground level concentrations of sulphur dioxide being well within regulatory standards. During operation of the proposed station the conventional air quality will be influenced by infrequent use of further gas turbine capacity. Ground level concentrations of sulphur dioxide will still be well below regulatory requirements.

Dose levels in the surrounding communities due to radioactive emissions from the existing station have been measured since 1971. There has been no detectable increase in background radiation dose rate levels due to the operation of the first three Units of the existing Pickering G.S. An increase in the level of tritium in air has been measured but the calculated resultant dose to the public is negligible. The proposed station will be designed to operate within design tar- gets of 1% of the Derived Release Limits for conformance with regulations on radioactive emissions. Area monitoring would continue to measure any changes to the natural background radiation levels due to opera- tion of the existing and proposed stations.

Wind data indicates that station emissions will be dis- persed over land areas approximately two-thirds of the year.

During construction, vehicle carrier traffic may cause some dust along routes leading to the site. Any problem will be minimized by keeping roads free of heavy deposits.

2.2 WATER

Existing water quality is generally good and is typical of a nearshore area close to urban developments. Nutrients, dissolved oxygen levels and radioactivity levels have not measureably changed since first operation of the existing generating station. Gross beta radioactivity levels in water which is used for the local drinking water supply are not measureably higher than levels in the lake, distant from the site.

Currents are generally variable in summer but become persistent in both directions alongshore in the fall. Except in the summer, direction of winds and currents agree closely. Offshore water temperatures vary markedly from day to day and within days. A thermocline develops in May or June, is greatest in early September and disappears in October. Temperature elevation due to the thermal discharge from two units of the existing station can be detected on the surface approximately one mile from the discharge point. With the existing intake structure, recirculation of cooling water occurs under some wind and current conditions. Modifications to the intake are being made to reduce this problem.

Fishing and spawning areas are not extensive in the off-shore area, but are present in the nearby rivers and streams. The thermal discharge from the existing station attracts more fish in the cooler months of the year than in control areas, but total populations are generally lower during the period July-September. Fish entrainment has occurred, particularly during the spawning period May-June, the predominant species being alewife and smelt, with very small numbers of game fish.

During the construction of the on-shore structures and the proposed offshore intake, dredging and dumping operations will add suspended material to the water and distribute

nutrients in the immediate controlled dumping area. These effects are predicted to be short-lived and localized based on experience of similar operations of another Lake Ontario site.

During operation of the proposed station the thermal discharges from both stations will create surface areas with temperatures above ambient up to approximately 2 miles off-shore or along-shore. The shape and extent of these areas are primarily influenced by the prevailing winds and currents. The off-shore intake will result in slightly lower intake temperatures during the period of thermocline development. Current modifications will occur near the intake and some interference with the littoral drift of suspended silt may occur at the shoreline. The thermal discharge from the proposed station will be directed to the east and will extend the along-shore, ice-free zone in the winter.

Water quality changes due to the input of heat and discharge of miscellaneous effluents are predicted to be small. Dissolved oxygen levels should not be reduced by either changes in solubility with temperature or increased biochemical oxygen demand. During operation of the existing and proposed stations, residual chlorine levels in the discharges should have little or no influence on aquatic organisms.

Losses of plankton, small fish and other organisms will occur due to mechanical and thermal shock when entrained in the condenser cooling water system. Losses of fish by impingement on the intake screens are also expected to be reduced by use of the offshore submerged intake.

The maximum expected thermal discharge temperature would adversely affect such common fish species as smelt and yellow perch if attracted and held at the maximum summer discharge temperature. However, existing data indicate that these species will move away from temperatures above their acclimation temperature. The thermal discharge is not expected to influence migration up nearby streams, but may attract and delay some fish during the spawning season.

The benthic community is expected to be only adversely influenced close to the outfall where discharge temperatures and strong currents may reach the lake bottom. Epiphytic algae composition will shift to a population dominated by green algae in the warmest months, but blue-green forms are not expected to become dominant. Phytoplankton growth in the area influenced by the thermal discharge is not expected to reach bloom proportions. Filamentous algae may grow and fragment slightly earlier in the year in the discharge area, but total biomass is expected to be unchanged or only slightly increased where currents are strong.

Station design will be such that releases of radioactive liquid wastes are expected to be within 1% of the Derived Release Limits.

The aqueous discharges to the lake derived from various oil waste sources, water treatment plant, and boiler alkaline flush waste lagoon will be controlled to meet existing or future sater quality criteria. The types and quantities of discharges are expected to have a neglible impact on water quality and the aquatic community.

The use of water in condenser cooling and other station processes is expected to have no influence on other industrial or public water uses in the area.

2.3 SITE AREA

The Pickering site was acquired over the period 1959-1967 and was laid out in 1964 for an 8 unit station. The existing station started to produce power in 1971 and reached full power

in 1973. The proposed extension would occupy the eastern portion of the property and would be connected to the east end of the existing station to form a symmetrical design around a central administration building.

The site of the proposed station has similar topography to that of the existing station. The site is presently occupied by construction and training facilities which would be moved to permit grading and clearing. The shoreline would be extended into the lake using excavated materials in a manner similar to that for the existing station. The main impact on the site area would be the excavation, mainly of bedrock, required to provide the structural foundations and cooling water passages. Excavation will lower ground water levels in the immediate area of the powerhouse. Ground water levels elsewhere on the site should not be affected.

No new property is required for the construction of the proposed station.

Limited quantities of spent fuel and ion exchange resin will be stored within the station but no permanent outdoor radioactive waste storage area is planned at the site.

Seismologically, the Pickering site is located in a relatively quiet area.

Vegetation in the proposed construction area has been previously removed for other on-site activities. A landscaping program will be implemented around the finished proposed station to complement the landscaping of the existing station.

Wildlife, particularly migratory water fowl, are located on the western edge of the Pickering site. The proposed construction is not expected to influence these bird populations.

2.4 LAND USE AND COMMUNITY

The Pickering site is located within the newly formed Central Ontario Planning Region which is an enlargement of the former Toronto-Centered Region.

The Toronto-Centered Region incorporated the former Central Ontario Region as well as portions of the former Lake Ontario, Georgian Bay, Niagara and Midwestern Economic Regions. Indications are that the eastern portion of this area can expect increasing economic activity and development in the future.

Population centers have been designated which could double the population in a 5 mile radius from the Pickering site by 1986.

There is adequate property on the Pickering site for a second station with no zoning problems.

Construction of a second plant would continue the present level of local spending with no associated extra municipal burden resulting from the need for additional temporary housing or educational facilities. The well developed existing medical, educational, housing and shopping areas can service the increased load due to construction and operational staff for the proposed plant.

The local road network will be exposed to prolonged used by heavy traffic. This situation could be alleviated by use of a rail spur into the site area.

No additonal land will be required for installation of extra transmission lines. The environmental effects on land use will therefore be minor.

2.5 CONCLUSIONS

(i) Non-radioactive emmissions to air from on-site sources will result in only minor effects on the existing air quality.

(ii) Routine radioactive gaseous releases from the station should meet or be lower than the design objectives which are 1% of the regulatory limits. The effect of such operation on radioactivity background levels in the vicinity will be minor.

(iii) Increases in the lake surface temperature due to the thermal discharge will not normally be detectable beyond a distance of two miles from the station.

(iv) Water quality is not expected to be adversely influenced by the thermal discharge or other non-radioactive releases beyond the immediate discharge area.

(v) Routine radioactive releases to water should meet or be lower than the design objectives which are 1% of the regulatory limits. The effect of such operation on radioactivity background levels in the vicinity will be minor.

(vi) Local temperature increases in the lake are predicted to have only a minor influence on fish spawning and will not act as barriers to migration up nearby streams. Spawning activity may be delayed due to attraction of some fish to the thermal discharge. At other times, fish which are attracted will be able to select a temperature which has little or no adverse effects.

Entrainment damage to plankton and young fish will occur. The proposed off-hore intake may entrain fewer organisms than the present shore-line intake.

(vii) Ground water levels will be lowered by on-site excavation but will be confined to the area surrounding the powerhouse.

(viii) Solid radioactive wastes other than limited quantities of spent fuel and radioactive spent resin will be stored off-site.

(ix) The shore line will be extended into the lake using materials excavated on-site.

(x) No new property is required for accommodation of the proposed station, its exclusion area and extra transmission lines.

(xi) The project can be readily integrated with the short and long term planning for the area.

(xii) The existing housing, medical, social and other community services are capable of accommodating the increased demand placed on them by the project construction and operating staff.

(xiii) Construction and operation of the station will provide an economic stimulus in the area.

(xiv) Heavy traffic will occur on local roads during peak periods in the construction period.

3.0 PROJECT PHILOSOPHY

3.1 INCORPORATION

The Province of Ontario is served by an electric power transmission grid, developed over a considerable period of time to supply the power needs of municipalities, industry and agriculture. Generating stations of various types, and sizes are incorporated into this grid to provide a power source of high reliability.

The method of incorporating a particular station into the grid depends upon the distance of the station site from the grid, existing land use, environmental influences, regional development plans and existing technology. It is Ontario Hydro's intention to consider all these factors in arriving at the method of incorporation.

Pickering is located near the load centre and is only four miles from a major transformer station. All land has been obtained for the interconnection of the station to the grid through this transformer station.

3.2 SITE DEVELOPMENT

The development of a site may directly follow the site selection and aquisition process or be delayed for many years. The scheduling for development may be influenced by regulatory agency requirements, economic conditions, the desire to prove out a new system before further development, environmental studies on the site and load growth requirements.

Data relating to all environmental factors affected by the development of a site is brought together in the form of an Environmental Assessment. The Environmental Assessment is presented to the provincial regulatory agencies and is also made available to the public prior to a meeting where matters concerning the project can be discussed. These matters are recognized to be the economic and social impacts of the project on the community, the recreational or industrial uses of lands and waters adjacent to the station buildings, the operating and potential accidental releases of harmful substances to the environment and the aesthetic and environmental effects of the development.

Assuming approval is given for the project, Ontario Hydro intends to develop the site in accordance with these interests and monitor closely all phases so that control is effective.

3.3 EMISSIONS CONTROL

Emissions control is concerned with such aspects of the proposed project as radiation, radioactive domestic and industrial wastes, non-radioactive domestic and industrial wastes, heat dissipation and noise. It is Ontario Hydro's intention to achieve the lowest practicable emission levels consistent with the avoidance of potentially harmful effects on the individual and on the environment. Monitoring will be carried out to ensure effective control.

The design targets for routine airborne and liquid radioactive releases from all Ontario Hydro nuclear generating stations is to be one percent of the Derived Release Limits (DRL's) which are based on the maximum permissible dose to a resident on the boundary of the exclusion area or on the maximum permissible population dose, whichever is the more restrictive. The one percent target is to apply independently to Pickering G.S.-A and the proposed Pickering G.S.-B.

The preferred method of dealing with potentially harmful emissions is to eliminate the sources. However, where management is necessary, it will be based on treatment or storage in keeping with established practice and government regulation. If storage is required it will be in the most stable form consistent with plans for future disposition. Facilities will be such that any leaks could be easily monitored and positively repaired. Transport of waste materials off-site will be in accordance with government regulation.

3.4 SAFETY

The main concerns involving safety are the effects of chronic and accidental releases of radioactivity from the station. It is the responsibility of the AECB to ensure that the station is designed to meet safety requirements that adequately protect the public. Detailed submissions are made to the AECB and are reviewed by the Reactor Safety Advisory Committee of the Board. It is Ontario Hydro's intention to construct a station which meets all safety requirements and regulations, and to undertake in-service inspections throughout the life of the station to ensure the station remains in a safe and reliable condition.

The basic control and protection philosophy for the reactors will incorporate a multiple channel regulating system separated to the maximum extent from a triplicated protective system. The protection system will include two completely independent and fully capable shut-down systems. Two computers, one being a backup unit, will be employed to carry out many complicated control functions reliably. The combined overall control and protection systems will be designed to run the station in the intended manner and to shut it down with safety and minimum damage to the station and the environment.

3.5 DESIGN, CONSTRUCTION AND OPERATION

The key to satisfactory fulfillment of a project is a comprehensive quality assurance program which includes everything necessary to engender confidence that the completed plant has been designed and constructed in such a manner that it can be operated efficiently and safely.

Important factors in such a program are competent personnel; clear complete specifications, procedures and assignment of responsibilities; frequent review audits (functional, reliability, maintainability, radiation exposure liability, safety); skill re-certification; effective quality control with complete documentation; and development of quality consciousness in all participants.

The design of the main buildings and structures will take into account parameters such as earthquake forces and wind velocity calculated in accordance with the provisions of the National Building Code of Canada.

While the reactor buildings will be basically designed to shield personnel from radiation during normal operation or shutdown, the design criteria will also take into account factors such as simultaneous occurrence of maximum accident loads, normal gravity loads and snow loads, combined with either wind or earthquake forces.

A vacuum structure will provide reserve volume for the containment of any high energy fluids released within the reactor buildings. Entry into the reactor buildings will be permitted only through airlocks so that the containment system integrity may be maintained unimpaired.

All relevant sections of the applicable codes will be adhered to in the design and contruction of the proposed station.

4.0 PROPOSED PROJECT DESCRIPTION

4.1 LOCATION AND DESCRIPTION OF SITE

The Pickering site is on the north shore of Lake Ontario at Moore Point in the township of Pickering, Ontario County. It is about 20 miles ENE of the city of Toronto and 13 miles WSW of the city of Oshawa, at latitude 43° 49'N and longitude 79° 04'W. Adjacent to the site is the community of Bay Ridges which occupies both the east and west sides of Frenchman Bay, south of the MacDonald-Cartier Freeway (Highway 401). The village of Pickering is about 3 miles north of the site, and the town of Ajax is about 3-1/2 miles to the northeast (Figures 1 and 2). The site occupies a land area of about 500 acres and stretches from lots 17 to 22, inclusive, in the Broken Front Concession. The total frontage of the site along the shoreline of Lake Ontario is about 8,000 feet.

The site was purchased, in sections, over the years 1959-1967 for the location of a generating station or stations with a total of 8 units. The existing station, consisting of four 508 megawatt units (MWe), is now operational, being completed in the summer of 1973. The proposed station will be located to the east and immediately adjacent to the existing four units of Pickering G.S. The site is serviced by two major provincial highways running in the east-west direction. The MacDonald-Cartier Freeway and Highway 2 are located about 2 miles north and are connected to the site by several good Township roads. The C.N.R. main line runs within 1-1/2 miles of the site and a dock has been constructed on the west side of Pickering G.S.

In succeeding sections of this document the east half of the site will be referred to as the site area for the proposed project.

4.2 STATION CAPACITY

The proposed station will consist of four generating units of the CANDU pressurized heavy water type, each capable of operating independently of the other units but using certain common services. Each unit is designed for a net electrical output of 508 MWe at 85 percent power factor, yielding a total plant net output of 2032 MWe. Power will be produced at 24,000 volts and delivered at 230 kilovolts and 60 hertz to the Southern Ontario grid.

Six gas turbines of 7.5 MWe capacity (total 45 MWe) will be provided for peaking capacity and black start capability.

4.3 UTILIZATION AND CAPACITY FACTOR OF STATION

Each reactor and turbine-generator will be capable of sustained operation at any load up to 100% of maximum rated output and can be shut down for weekends.

For economic evaluation, the 30 year lifetime average capacity factor is assumed to be 80%, ranging from an average of 70% the first year after startup to an average of 82% each year after reaching maturity (about five years after startup). Experience so far with Pickering G.S.-A indicates better-than-expected performance.

Due to the relatively high capital cost and low operating costs of nuclear stations compared to fossil fired stations, it is planned to operate the proposed station as a base load unit operating at the high capacity factors mentioned above.

The six gas turbines (burning light distillate oil) will be run-up periodically for checking, and used during peak power demand periods for supplemental power. Total usage is not expected to exceed 500 hours per year.

4.4 SCHEDULE

A schedule for a 4 x 508 MWe nuclear addition to the Pickering site is given in Figure 3.

4.5 MANPOWER REQUIREMENTS

4.5.1 Construction

For the proposed project, it is estimated that construction manpower requirements would peak at approximately 3350 men.

4.5.2 Commissioning

The manpower required for commissioning is projected to be approximately 840 man-years. This is about 30 percent less than the estimated requirement for Pickering G.S.-A.

4.5.3 Operation

The operating staff required for Pickering G.S.-A and the proposed station will be approximately 525 at maturity. Pickering G.S.-A by itself requires a staff of 325(29).

4.6 GENERAL SITE LAYOUT AND PROPOSED STATION ARRANGEMENT

The site layout and station arrangements are shown in Figures 4 and 5 respectively.

The proposed station is to be located in line with and adjacent to the east end of Pickering G.S.-A. It will be connected to and will share the facilities of the present two-storey Service Wing and the existing vacuum building.

Each of the four reactors, together with its associated boilers and closely related auxiliary equipment and systems, is located in a separate 140-foot internal diameter reinforced-concrete reactor building. Associated with the two groups of four Reactor Buildings, and connected to them by a large duct, is a Vacuum Building, which is maintained at an absolute pressure of about 2 psi. The combined volumes of the Vacuum Building, the duct and any one Reactor Building constitute an "emergency containment system" which is designed to ccontain all airborne radioactive effluents which might result from a reactor system failure.

Associated with the group of four Reactor Buildings and connected to the northerly half of the perimeter of each, is a two-storey Reactor Auxiliary Bay. This building contains reactor auxiliaries and secondary circuits of low radioactivity level, new fuel storage, a spent fuel storage bay and the station control centre.

The Service Wing, occupying the central position in the ultimate two station arrangement, is connected to both the Reactor Auxiliary Bay and the Powerhouse. It contains maintenance shops, change rooms, and a decontamination centre. The station laboratories will be the production control offices for both stations.

The four turbine-generators are arranged in line in the turbine hall of a steel frame powerhouse which runs the length of and adjoins the Reactor Auxiliary Bay. The Powerhouse also contains the circulating and service water pumps, in addition to the conventional steam and electrical power equipment.

The present Administration Building, providing office and administration facilities, personnel entrance to the Service Wing via an elevated passageway, telephone and public address equipment rooms and a cafeteria, will serve the whole site.

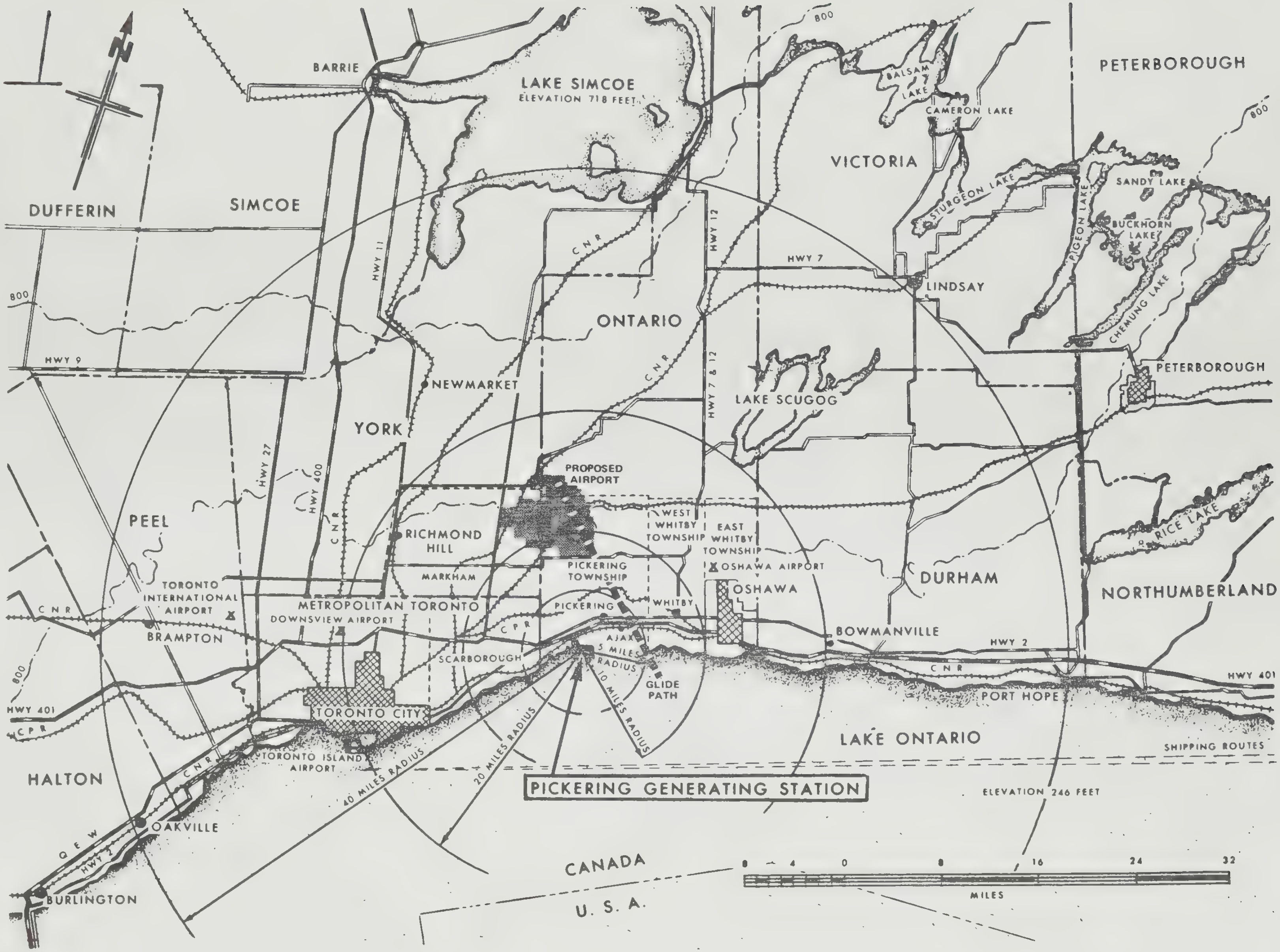


FIGURE 1 SITE LOCATION – 40 MILE RADIUS

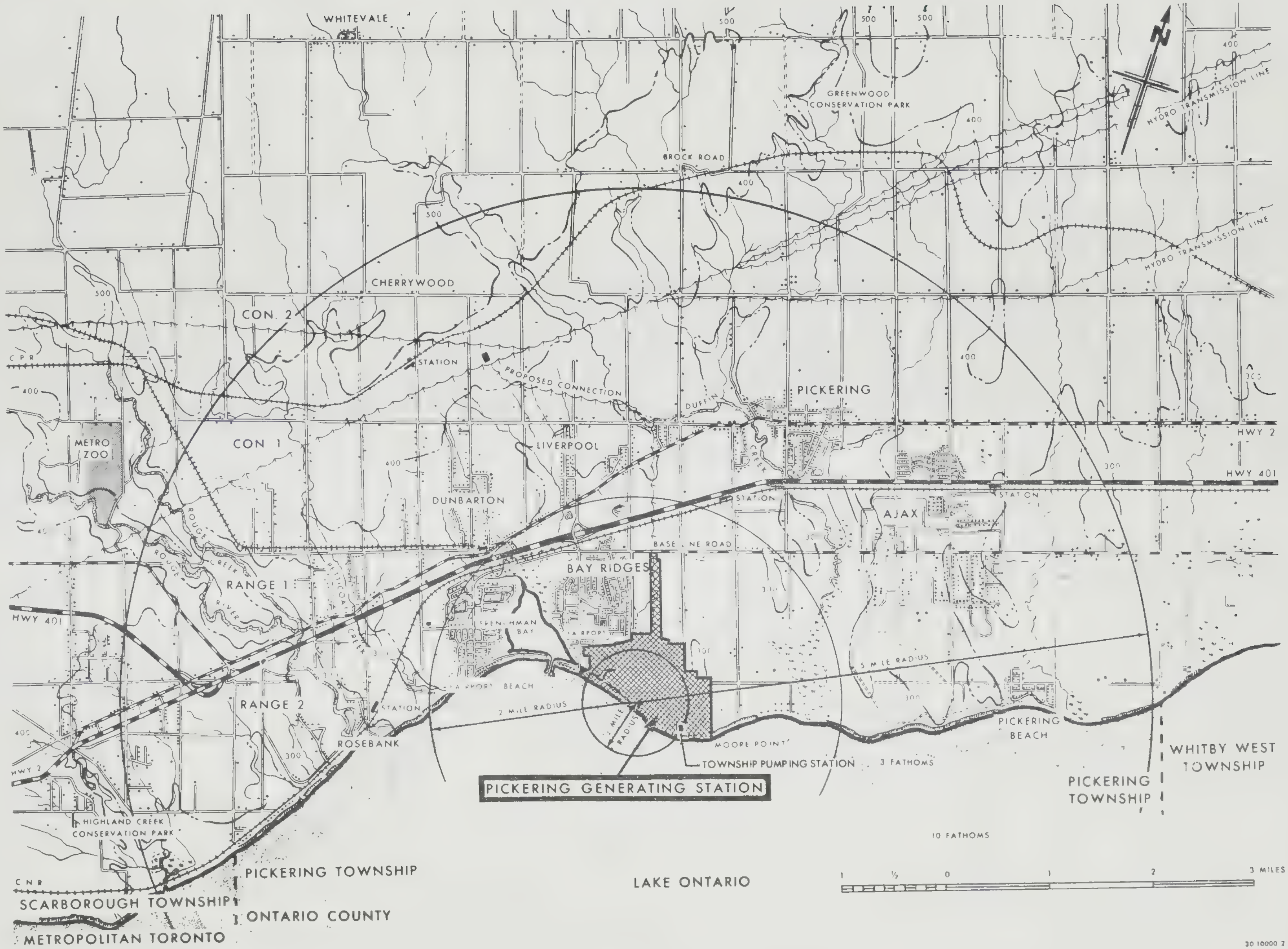


FIGURE 2 SITE LOCATION – 5 MILE RADIUS

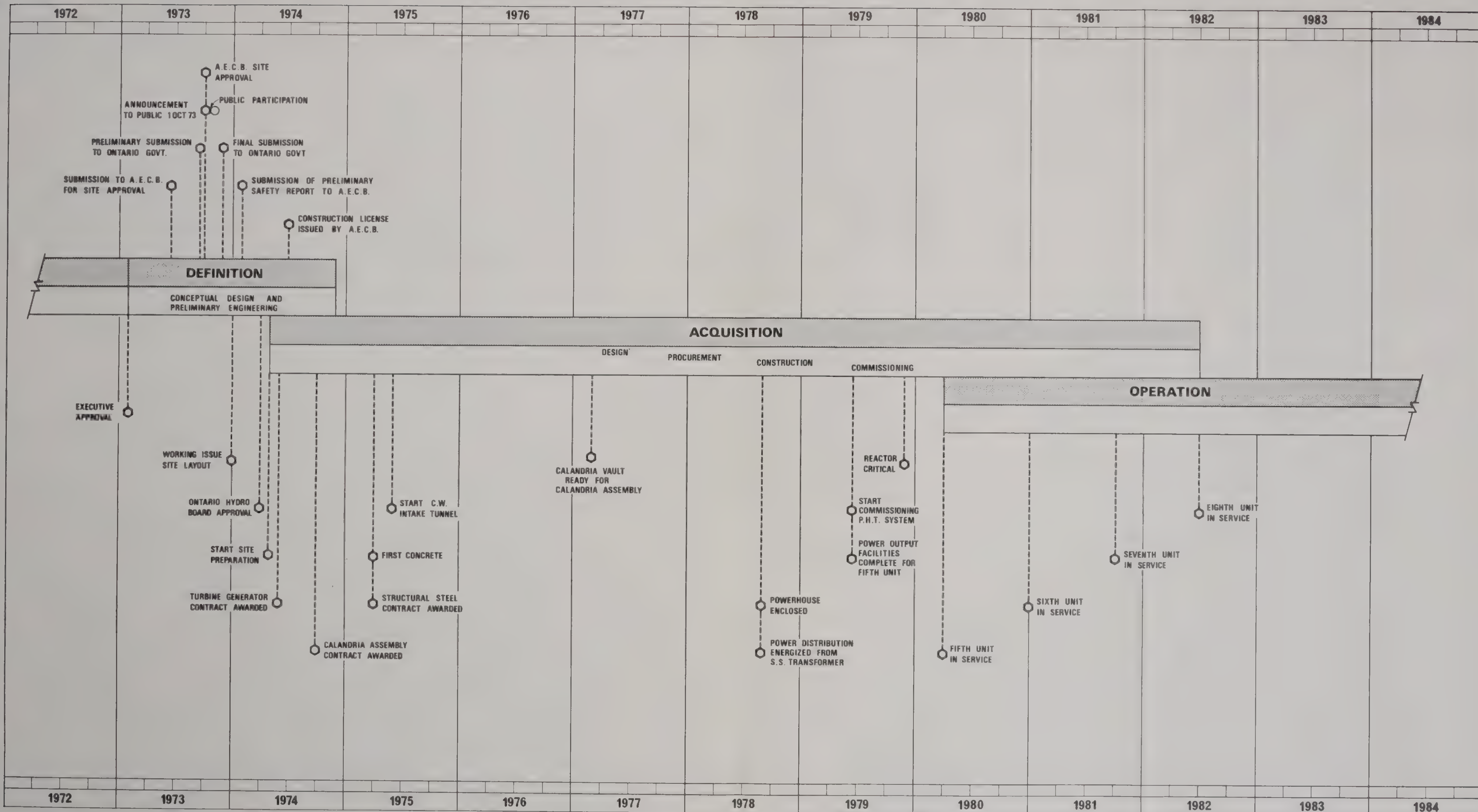


FIGURE 3 SCHEDULE

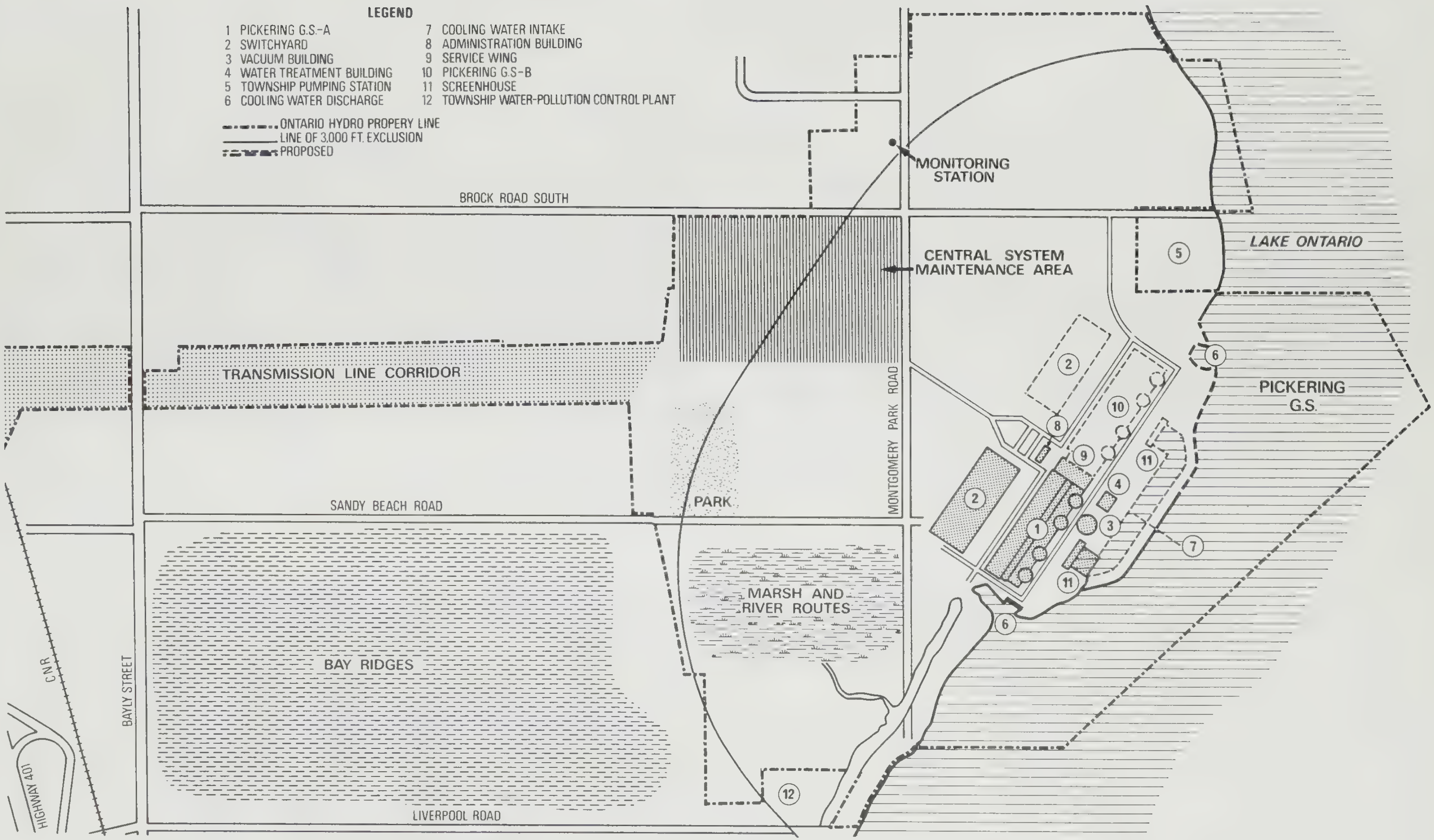


FIGURE 4 SITE LAYOUT

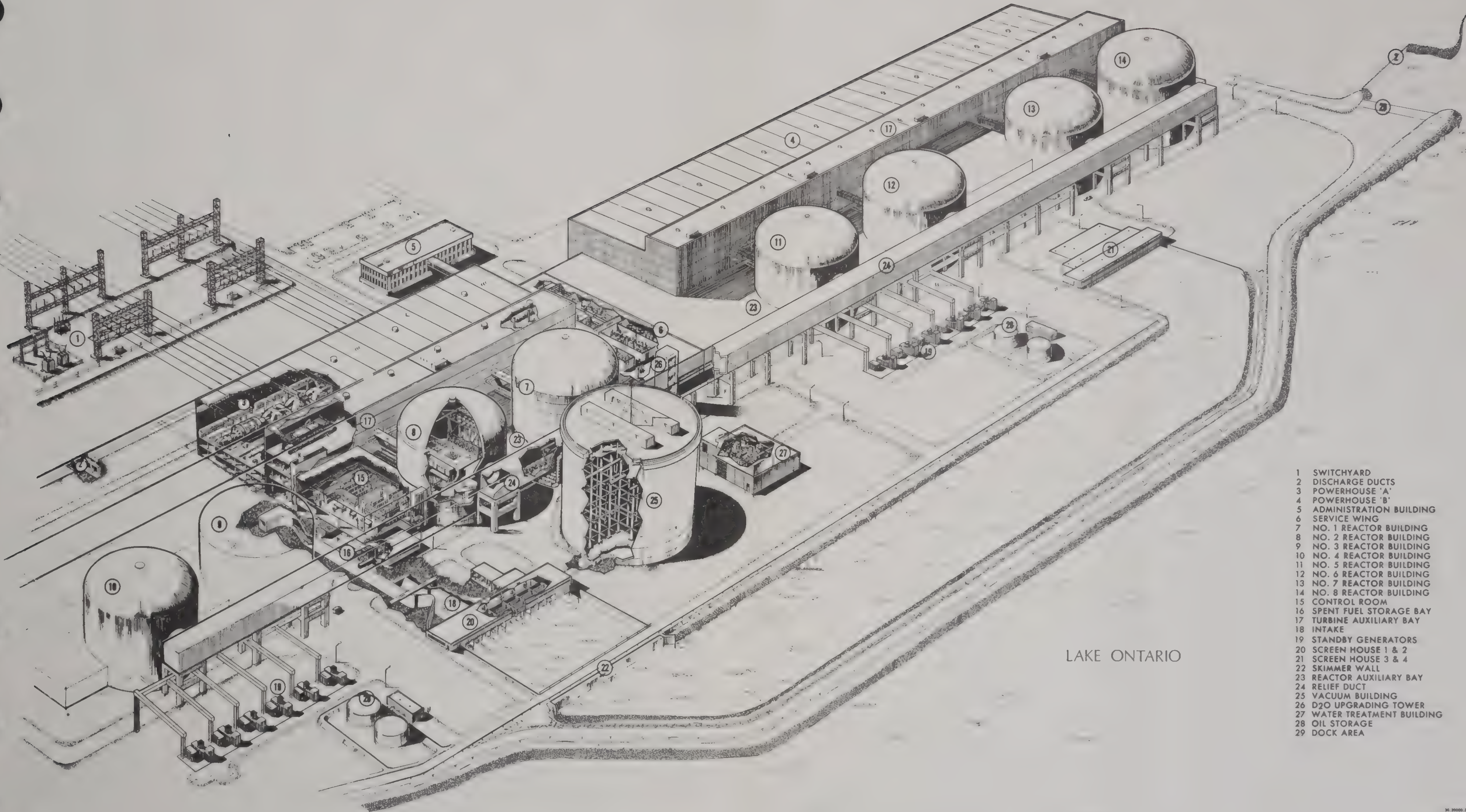


FIGURE 5 PROPOSED PLANT ARRANGEMENT

4.7 STATION DESCRIPTION

The station will basically comprise four nuclear reactors, four turbine generators and associated equipment and services yielding a total station net output of 2032 MWe. The steam will be raised by a heavy-water-moderated, pressurized heavy-water-cooled, natural uranium dioxide fuelled reactor and a steam supply system. Each reactor and boiler system will serve one turbo-generator system.

The steam raised in the nuclear steam supply system at 585 psia and 483°F will expand through a conventional steam driven turbine system producing a nominal output of 540 MW. The steam will be condensed to water in the condenser and this water will then be pumped through three stages of low pressure feedwater heaters, one deaerating heater and two high pressure feedwater heaters. The feedwater will then return to the nuclear steam supply system at 340°F.

4.7.1 Steam Supply System

The heat transport system associated with each unit consists of two main circuits. In the primary circuit, which contains heavy water (D_20), the heat is extracted from the fuel. This heat is transferred via twelve steam generators (boilers) to a secondary circuit which contains light water (H_2O). The light water steam generated in the boilers is used to drive the steam turbine.

Incorporated in the primary circuit are pressure tubes containing the fuel bundles, the associated end fittings and feeders, inlet and outlet headers, primary coolant pumps and the above-mentioned boilers. The circuit is designed such that the flow in adjacent fuel channels is in opposite directions. The primary circuit is effectively divided into two separate loops. The temperature of the primary coolant is raised approximately 80F° to 560°F in passing through the reactor but the primary system is pressurized thus preventing boiling of the primary coolant.

The saturated steam generated in the secondary circuit is at a pressure of approximately 585 psia and 483°F under full load conditions. It is dried to 99.8% quality by cyclone separators in the steam drum before delivery to the turbine.

4.7.2 Turbine Generator System

The station will comprise four turbo-generator units and associated condensing and feedwater systems, each unit working independently in conjunction with its own steam supply system. Each turbine unit will comprise one double-flow high-pressure cylinder followed by moisture separators, steam reheaters and three double-flow low-pressure cylinders.

The turbine generator units will be single shaft machines with a speed of 1800 rpm and a nominal net output of 540 MWe each. Each generator will be rated at 635 MVA at 45 psig hydrogen pressure. The power will be produced at 85% power factor and 24,000 volts and delivered to the grid at 230 kV and 60 hertz.

At full load, each steam supply system will supply 5,970,000 lb/hr steam at 585 psia and 483°F to the high-pressure cylinder. As this steam expands through the turbine, its water content will increase. At the high-pressure turbine exhaust, the steam and water mixture will pass through a centrifugal separator where most of the water will be removed and extracted to a feedwater heater. The steam will pass to a tube type reheater where it will be reheated to 435°F by main steam from the nuclear steam supply system. The reheating steam will

be condensed in the reheater tubes and the collected condensate pumped back to the steam supply system. Six stages of feedwater heating will be provided in all, three horizontal low-pressure heaters, one deaerating heater and two horizontal high-pressure heaters. The total steam flow, including reheat is 6,453,175 lb/hr.

Three 50% duty condensate pumps will take condensate from the condenser hotwell and pump it through the three low-pressure heaters to the deaerating heater. Condenser air removal will be affected by three rotary type mechanical vacuum pumps with normal operation requiring one pump, the remaining two being for standby and evacuation duty during start-up.

Feedwater from the deaerating heater will flow to the suction of three 50% duty constant speed electrically driven boiler feed pumps which will supply feedwater through the two high-pressure feedheaters to the nuclear steam supply system. The feedwater entering the boiler will be at 340°F.

The stator windings of the generator, which will comprise hollow copper conductors, will be cooled by circulating cooling water through them. The rotor of the generator will be hydrogen cooled. The system will include heat exchangers to dissipate the heat produced in the stator windings.

The start-up of the turbine up to synchronization will be programmed into the unit computer. Any abnormal operating conditions such as excessive vibrations will be fed into the computer automatically and displayed on annunciators on the control panel.

4.7.3 Cooling Water System

The proposed station condenser cooling water (CCW) and service water will be drawn from Lake Ontario through an offshore intake which will be common with Pickering G.S.-A. The intake will bring the water in at a rate of 448,800 USGPM for each unit to a common forebay. Bar screens and travelling screens in series will remove trash and fish down to 3/8 inch square size. The CCW pumps take suction from wells behind the screenhouse area, feeding water to the condensers, service water systems, and for auxiliary cooling needs. Discharge will be via a surface discharge channel to the east of the proposed station. The outfall temperature will not exceed 20F° above the temperature of the intake water. The T of 20F° meets regulations for the discharge of heated water to Lake Ontario. Tempering of the discharge with ambient lake water to meet regulatory limits is not required.

4.7.4 Waste Management Systems

It is Ontario Hydro's intention to install radioactive waste management systems for Pickering G.S.-B, which will be designed to meet the targets of 1% of Derived Release Limits (DRL).

4.7.4.1 Site Drainage and Sewage

The site drainage for the station will be conventional, but special under drainage systems with sampling connec- tions will be provided for certain areas of the station. Sewage from all urinals and toilets, washwater from Zones 1 and 2 and personnel showers will be piped through the interconnecting sewage pipe to the municipal sewage system.

4.7.4.2 Radioactive Liquid Wastes

Radioactive liquid effluents from the station will be monitored and sampled. Routine releases will be via the condenser cooling water discharge channel on a batch basis from

collection tanks following laboratory analysis. Although the regulatory limits for this station require a permissible discharge concentration not be exceeded over a monthly averaging period, with instantaneous concentrations of ten times this level permitted, it is the intent that the calculated activity concentration of any given batch after dilution will not normally exceed the regulatory limit. Further, the design target is that, on an annual basis, the average discharge concentration should not exceed 1% of this limit. Achievement of this target may require the use of clean-up techniques which could include charcoal beds, ion exchange and chemical precipation systems. As further protection, a continuous activity monitor will initiate automatic shut-off of discharge from the collection tanks if a preset level is exceeded. As a final check on the amount of activity actually released to the lake, a sampling pump will be installed at the end of the condenser cooling water discharge channel. Such samples will be analyzed in the laboratory to determine the monthly average activity concentration which reaches the lake in the effluents.

The sewage and service water systems will also have pump sample systems similar to that in the cooling water channels..

Active waste liquids are placed in three categories for handling and disposal:

(i) Normally Inactive Liquid Wastes

(ii) Active Liquid Wastes

(iii) Active Chemical Liquid Wastes

The above three categories of waste will be collected in separate tanks and then processed and/or dispersed on a batch basis.

(i) Normally Inactive Liquid Wastes

This category will consist mainly of shower and washroom drainage discharge and will not normally contain radioactive wastes. However, after collection in tanks they will be analyzed for activity, and diluted if necessary to meet the above limits prior to being pumped through the station sewage system to the Pickering Township system.

(ii) Active Liquid Wastes

This category will normally consist of low activity liquids. These wastes could be from the decontamination facilities, plastics and cotton laundries, Service Building and Reactor Auxiliary Bay active area floor drains, which will be drained into collection tanks.

(iii) Active Chemical Liquid Wastes

This category may consist of liquids of high chemical and/or activity content. Major sources could be from the laboratory and decontamination centres. Collection will be in a designated tank, the content of which will be mixed and analyzed on a regular basis. Provision will be made for neutralizing the waste. Wastes having activities and chemical content less than prescribed values will be pumped into the category (ii) collection tanks, as required, without restrictions. Higher activity liquids will be processed.

4.7.4.3 Radioactive Gases

Radioactive gaseous effluents from the station can be filtered and monitored prior to release to the atmosphere. Release will be via stacks situated on the roof of the Reactor Auxiliary Bay. The gaseous release limits are based on a seven day averaging period and ensure that the maximum permissible annual dose for an individual on the boundary is not exceeded.

The design and operating target is that, on an annual basis, the activity released to the atmosphere from Pickering G.S.-B should not result in a dose of greater than 1% of the regulatory limits.

There are two distinct groups of potentially radioactive gaseous effluents which can be identified. These gaseous streams are dealt with in different ways.

(i) An off-gases management system is presently under design and will be incorporated into the station. This system will manage off-gases from the heat transport system lead condenser and the fuel transfer rooms of the individual units.

(ii) All active or potentially active gases, vapours or airborne particulates which may be expected to occur in the Reactor Buildings will be filtered and monitored, if necessary, prior to release to the atmosphere. The exhaust monitoring systems will consist of iodine, particulate and noble gas monitors and a tritium sampler for each exhaust route. Dampers in exhaust ducts will close on indication of high iodine activity. In areas where there is a significant continuous activity release to the building atmosphere, closed ventilation systems which recirculate the air will be used. These systems include provisions for purging.

4.7.4.4 Radioactive Solid Wastes

Various solid wastes will be stored in different ways depending on the nature of the waste. Filters, ion exchange resins and various other wastes will be stored in an engineered waste management area presently under construction at the Bruce Nuclear Power Development site on Lake Huron. Bulk spent resin will be slurried to storage tanks for intermediate-term decay storage prior to off-site shipment. Spent fuel will be stored underwater in on-site spent fuel bays. There will be sufficient storage capacity for several reactor-years worth of spent fuel. At some time in the future, spent fuel will be transferred to central off-site storage areas.

Management of radioactive wastes, in all cases, will be based on the concept of retrieval at some future date. Retrieval means that provision must be made, in each waste storage area, to recover intact all the waste stored at the site.

The shipment of radioactive waste material from Pickering to Bruce Nuclear Power Development, complies with the transportation regulations governing radioactive shipments in Canada. These stringent Canadian regulations are based on the recommendations of the International Atomic Energy Agency (IAEA).

There are two types of packages used in the transportation of radioactive wastes by Ontario Hydro, Type A and Type B. A Type A package is one which could be shipped by any commercial carrier along with other articles on the vehicle and is, therefore, restricted to very low quantities of radio-activity. The packages are designed to withstand the normal conditions of transport and must pass such tests as a drop from a height of 1.2 meters onto an unyielding surface and a penetration test by a narrow round-ended bar. Type A packages which contain liquid must either be able to withstand a drop from 9 meters without failure or contain enough absorbent material to absorb twice the volume of contained liquid.

Type B packages are designed to hold larger quantities of radioactive material and must, therefore, have greater shielding capabilities. They are subjected to even more stringent tests than Type A packages. They must be able to retain their shielding and containment features after being subjected to a drop from 9 meters onto an unyielding surface, a penetration test and immersion in an open fire at 800°C for one half hour and then left to cool naturally for three hours before any artificial cooling may be applied.

The spent ion exchange columns and filters are transported to the waste management site in a specially designed Type B package which consists of a lead and steel shielding container inside a shock absorbing overpack. The ability of the package to maintain its integrity after being subjected to the above tests can be better appreciated when it is realized that each package weighs 11 tons.

Nuclear power reactor wastes are not economically shipped by air, though regulations do exist which control this aspect of nuclear wastes within Ontario Hydro (112). At the moment there are no railway facilities for shipment from the Pickering site to the Bruce Radioactive Waste Management Area. Thus all shipment is carried out by highway truck carrier. Ontario Hydro policy is to use Hydro trucks for transport of all radioactive material from Pickering to the Bruce Radioactive Waste Management Area.
Since there have been no deaths, injuries, or serious releases of radioactive materials in transport accidents during the 25-year life of the nuclear industry only theorectical analysis of accident risks is possible. A recent study of the probability of severe accidents involving trucks has been carried out (80). This study concludes that, with regard to the probability of serious public consequences of transportation accidents involving radioactive materials, the probability of death, injury, or massive property loss due to transportation of radioactive materials is determinable, not zero, but very small. Before any shipment of radioactive material leaves Pickering G.S., a form listing the number of packages being shipped and their contents is given to the driver of the transport. Included on this form are instructions on what must be done in case of fire, accident, breakage, etc. The following section from the form details procedures to be followed in the event of an accident to material in transport:

"In case of fire, accident, breakage or otherwise damaged and leaking containers, the containers or equipment contaminated by spillage, should not be moved. Persons should remain a minimum distance of 50 feet from the containers. Approach the containers only of urgent necessity, minimize time, maximize distance, approach upwind, preferably with protective clothing and dust mask, if available. Avoid inhalation, ingestion or contact with radioactive material. Request assistance of a radiation expert at the earliest instance by contacting the local police. (In Ontario, contact the local O.P.P. detachment and if the detachment does not reply, call ZE5-0000). Report location, details of package(s) and contents, name of shipper and extent of injury and damage. Rescue injured as quickly as possible. Advise ambulance/hospital of possible radioactive contamination. Other persons who are contaminated should remove outer clothing, wash exposed skin areas, and must remain at the scene until checked by a radiation expert. Prevent persons and equipment from moving through suspected contamination areas until such areas are declared safe by a radiation expert. If fire occurs, combat it, minimizing radiation exposure, and minimize inhalation or contact with contaminated smoke or materials."

The probability of leakage of radioactive materials from "approved" containers following a transport accident, fire, etc. is very low due to the stringent requirements placed on containers and flasks utilized for radioactive material transport.

4.7.4.5 Water Treatment Plant Wastes

The water treatment facilities will consist of a pretreatment system and a demineralization system.

The pretreatment system, prepares raw lake water for demineralization and consists of two raw water supply pumps, a chlorination system, a chemical feed system, a clarifier-softener of 1,180 USGPM capacity, two sand filters of 590 USGPM capacity each and a filtered water storage sump of approximately 400,000 US gallons capacity.

The demineralization system consists of two lines of equipment for dechlorination and demineralization of the filtered water. Each line consists of a filtered water transfer pump, an activated carbon purifier, a cation exchanger, anion exchanger and a mixed bed exchanger.

A neutralizing sump serves to collect the backwash water and regenerant solutions from the ion exchangers and activated carbon purifiers. It has an approximate capacity of 400,000 US gallons.

The clarifier-softener blowdown will be routed by gravity through a settling basin located south of the water treatment plant. After settling has taken place, the liquid will overflow to the neutralizing sump where samples are taken for chemical and radioactivity analysis. Retention time in the settling basin will be at least two to three days with some 400 to 500 pounds of suspended solids settling out per day. It is estimated that the clarifier softener blowdown can vary from 5,000 to 15,000 US gallons per day, depending on the plant service factor and impurities in the lake water. Tests carried out during 1970 and 1971 indicate that 80 to 90% of the suspended solids will have settled out during the first 24 hours after being discharged to the settling basin. The suspended solids consist mostly of calcium carbonate.

The basin will be emptied every few years when the settled volume builds up, at which time approval for the disposal of the solids will be obtained from the Waste Management Branch of the Ministry of the Environment. During the period of several weeks when the settling basin is being emptied, it will be necessary to by-pass the basin and discharge the clarifier blowdown direct to the neutralizing sump.

The sand filter backwash will continue to be routed direct to the neutralizing sump. It is estimated that this backwash will contain less than 75 pounds per day of suspended solids.

Neutralizing sump contents will then be sampled for pH and then discharged to the condenser cooling water discharge channel. If the neutralizing sump pH is outside limits or if the number of CCW pumps is insufficient for adequate dilution, neutralizing will be added to maintain the discharge within the pH limits.

4.7.4.6 Oil Contaminated Drains

A system is to be developed for routing oil contaminated drains to a central treatment area. The oil will be recovered and the clean water then discharged to the lake via the normal drainage system.

4.7.4.7 Chlorination

Chlorine may be added to the condenser cooling system periodically to prevent the accumulation of biological slimes and entrained materials on condenser tube surfaces. General practice is to add chlorine in sufficient amounts to satisfy the chlorine demand of the system

and to provide a residual level not exceeding 0.5 ppm in the condenser discharge. Typically, dosage is for 20 minutes every six hours for each half of a condenser. If this schedule is carried out sequentially, the theoretical maximum residual chlorine in the total cooling water discharge during four unit operation will be 0.06 ppm. In practice, the chlorine demand of the untreated condenser cooling water will further reduce this figure.

4.7.5 Fuel and Fuelling

The fuel assemblies for the CANDU reactors at the present time are bundles of cylindrical elements made up of compacted and sintered natural uranium dioxide (UO_2) pellets in Zircaloy sheaths. There are twelve fuel bundles per fuel channel, representing a total weight of approximately 116 tons of UO_2 in the reactor core.

The nuclear characteristics of the CANDU reactor system are such that it is necessary to refuel the reactor while it is operating. To do this, there are two remotely controlled fuelling machines associated with each reactor. Each machine attaches itself to an end fitting of a fuel channel in which the fuel must be replaced and one machine, which contains new fuel, pushes new fuel bundles in multiples of two into the fuel channel while the other machine, which is empty, receives the spent fuel pushed out of the opposite end of the channel. The capabilities of the fuelling machines are such that at one time up to ten bundles of fuel in multiples of two may be replaced per channel.

4.7.6 Upgrading Plant

The existing plant will be used to upgrade heavy water from Pickering G.S.-B. It consists of a train of five distillation towers operating under vacuum, a system to maintain vacuum on the towers, and tankage for feed and product storage. Downgraded water may be fed into one of several points on the towers such that the isotopic concentration corresponds closely to the concentration profile in the distillation towers. Reactor grade water, 99.8% weight D_20, is withdrawn from the bottom of the last tower in the train and passed through the product evaporator for final purification. Overhead distillate from the top of the first tower in the train contains less than 1% by weight D_20 and is split into the reflux stream which is returned to the tower, and the tails or reject stream which is mixed with the plant cooling water and discharged to the lake.

4.8 AMENITIES AND LANDSCAPING

Ontario Hydro has set aside an area within the exclusion radius for the Pickering site as a public park and wild life sanctuary and now utilizes the services of the Metropolitan Toronto and Region Conservation Authority to maintain control of this park and wild life area. This area is at the western side of the property and includes the marsh which is to be preserved in its natural state (Figure 4).

Landscaping of the proposed site upon completion will be integrated with that of Pickering G.S.-A.

4.9 GRANT-IN-LIEU PAYMENTS

Under the terms of the Power Commission Act of Ontario (Chapters 46 and 47), Ontario Hydro is required to pay a grant-in-lieu of taxes. These yearly payments are made to Pickering Township based on a combination of the assessed value of the land and of the station and service facilities.

5.0 LEGAL REQUIREMENTS

5.1 RADIATION EXPOSURE REGULATIONS

The Atomic Energy Control Board (AECB), a federal agency, was created in 1946 by the Atomic Energy Control Act as the regulatory agency for atomic energy in Canada. The AECB reference dose limits for exposure of the public have been outlined (31,32,69). These limits are based on recommendations by the International Commission on Radiological Protection (ICRP). At the provincial level, "radiation" has been included as one of the contaminants whose release may be subject to provincial review as outlined in the amended Environmental Protection Act,1971, (Ontario), (33).

At the international level, the International Joint Commission (IJC) makes mention of radioactive materials as a possible pollutant (14).

The radiation dose limits for members of the public, as set by the AECB, and recommended by the ICRP are given in Table 5.1.

TABLE 5.1

RADIATION DOSE LIMITS

Organ	Annual Dose Limits
Whole-Body, Gonads, Red Bone Marrow	0.5 rem
Skin, Bone, Thyroid	3 rem*
Other Single Organs	1.5 rem
Extremities	7.5 rem

* Although the thyroid dose limit in the existing regulation is 3 rem/year for normal operation, Ontario Hydro is aware of and is using the recommendation of ICRP No. 9, which is 1.5 rem/year to the thyroid of children up to 16 years of age.

These limits apply to the combined total of normal plus abnormal releases from an operating nuclear plant. "Abnormal" refers to releases arising from single failures in the essential process equipment. The frequency of failures in the essential process equipment that would result in a dangerous release of fission products from the equipment if the protective devices fail to operate, should not exceed once in three years per nuclear power station (32).

The AECB further limits the population dose to:

(i) 10^4 man-rem per year to the whole body

or (ii) 10^4 thyroid-rem per year per site.

For gaseous radioactive releases, the integration extends over all areas outside the exclusion area in which the external individual dose exceeds 1% of the individual dose at the station boundary. The exclusion area is the area within approximately one kilometer of the station buildings.

The dose limits set by the AECB are not regarded as design targets but are regarded as maximum limits which must not be exceeded. The ICRP recommendation that all exposures be kept as low as practicable (35) is supported by the nuclear industry in Canada.

5.2 AIR QUALITY

5.2.1 Federal (Radiological)

The amount of radioactive airborne material that may be released from a nuclear station to the atmosphere is governed by the maximum dose limits set out by the AECB (see Section 5.1). It is necessary to convert these limits, which are given in rem, to some other basis which will be more useful to the designer. Following AECB and ICRP recommendations (34, 101), dose conversion factors have been produced which relate dose limits in rem to maximum permissible concentrations in air (MPCa) for continuous exposure. The dose conversion factors take into account various factors such as most susceptible individual in the population to a particular radio-isotope, most susceptible organs, method of uptake, etc. In Table 5.2 which lists MPCa's, a critical uptake pathway is through the food chain. Children, who drink a large quantity of milk, are the limiting group for concentration of several radio-isotopes in the air over farm land.

TABLE 5.2

MPC_a FOR CONTINUOUS INTAKE

Radionuclide	MPC_a		
	External Irradiation $\frac{\gamma \text{Ci-MeV}}{m^3}$	Inhalation Ci/m^3	Food Chain (Milk) Ci/m^3
(1) Noble Gases	6.4×10^{-8}		
(2) I-131*		3×10^{-11}***	6×10^{-13}***
(3) H-3		3×10^{-7}	
(4) Particulates:			
Cs-137		1.5×10^{-9}	5×10^{-11}
Cs-134		1×10^{-9}	1.5×10^{-11}
Sr-90		4×10^{-11}	1.5×10^{-12}
Sr-89		2×10^{-10}	1.5×10^{-11}
Co-60		9×10^{-11}	
Ru-106		4×10^{-11}	
Unidentified** Particulates		1.5×10^{-12}	

* Assumes 50% of the dose is from the shorter-lived radioiodines accompanying I-131

** The lowest MPC_a value under "particulates" is used as the MPC_a for unidentified particulates. Measurement of unidentified particulate activity in the stack effluent will be based on the counting efficiency for Cs-137.

*** Based on 1.5 rem to child's thyroid.

The figures in Table 5.2 are based on the assumption that only one isotope is present at any one time; if several isotopes are present, their combined effect must be considered. Similarly, there may be other sources of radioactivity such as drinking water, edible fish, etc., that may contribute to the overall dose received. In addition, the MPC's apply beyond the site boundary regardless of the number of radioactive waste emitting installations located there. More extensive information is given elsewhere (63). It must be emphasized that the above values represent the legal maximum permissible concentrations of radionuclides in respirable air available to the public on a continuous basis(except for I-131 MPC's which are based on a dose of 1.5 rem/year to a child's thyroid rather than the legal dose limit of 3 rem/year).

For design purposes, the MPC_a's must be converted to Derived Release Limits (DRL's). The DRL's have units of curies per unit time and they are the best estimate of the maximum permissible average release rates if compliance with the maximum permissible dose limits for the public is to be ensured. The following formula indicates the relationship between DRL's and maximum permissible concentrations of radionuclides in air available to the public.

$$C = KQ$$

where Q is the release rate (typically) Ci/sec.

C is the concentration at a given distance from the source Ci/m^3

K is the dilution factor sec/m^3

The dilution factor K is a function of the distance from the source, the effective height of release, the weather and the averaging time i.e., the time over which it is measured.

5.2.2 Federal (Non-radiological)

The Federal Department of the Environment is responsible for enforcing regulations under the Clean Air Act, 1971, relating to ambient air quality and control of air pollution in Canada. The Act, limited in scope by the provisions of the British North America Act, is designed to assist provincial agencies in maintaining desirable ambient air quality.

5.2.3 Provincial

The Air Management Branch (AMB) of the Provincial Ministry of the Environment is responsible for enforcing regulations under the Environmental Protection Act, 1971, to attain desirable air quality in the province. It achieves this by:

(i) Regulating specific components in fossil fuel.

(ii) Enforcing standards on impingement levels of emitted pollutants and on air quality criteria.

(iii) Maintaining an air pollution index to signal and hence avoid potential air pollution episodes.

(iv) Issuing "Control Orders" and "Stop Orders" where emissions may produce damage or cause danger to health.

(v) Classifying sources of contaminants and prescribing maximum permissible levels of certain contaminants.

The operation of a power generating station must meet legal requirements regarding atmospheric emissions. Legal requirements for radioactivity emissions at Pickering are promulgated at the Federal level. However, the fossil fueled combustion turbines and diesel generators do emit conventional air pollutants which come under provincial jurisdiction. These requirements may include any or all of the following as defined under the Environmental Protection Act, 1971, by the Air Pollution Control Act, 1967, and its amendments.

(i) Limitations of sulphur content of the fuel.

(ii) Standards for concentrations of air contaminants at point of impingement.

(iii) Criteria for ambient air quality.

(iv) Regulations on plume opacity.

(v) Limitations on operation due to air pollution index regulation.

(vi) Regulations to prevent discomfort to persons, loss of enjoyment of normal use of property, interference with normal conduct or business or damage to property.

At this time, (i) and (v) of the foregoing, although applicable in other parts of the province, do not apply to this site area, but could be implemented at any time.

Incinerators are also regulated by the Air Management Branch and must be operated in an approved manner with any control equipment deemed necessary by the agency.

Desirable levels of certain contaminants have been set out in the legislation as criteria for ambient air quality. Impingement levels of contaminants emitted from sources are also set out in the regulations so as to achieve and maintain these ambient levels.

Emission rates of contaminants are not subject to regulations at this time.

5.2.4 International

The Canadian and United States Federal governments under the International Joint Commission confer on transboundary emissions. This commission has no power of enforcement, but makes recommendations where international boundary problems exist.

5.3 WATER QUALITY

5.3.1 Federal Regulations

5.3.1.1 Release of Radioactive Liquids

The amount of radioactive liquid material that may be released from a nuclear plant to a water body is governed by the maximum dose limits set out by the AECB (Section 5.1). The two main exposure pathways to man are by drinking water and consuming fish containing various radionuclides.

Maximum permissible concentrations of radionuclides in the station outfall have been

specified based on the legal dose limits. Various factors such as most critical group, uptake mechanisms, probable consumption, etc, have been taken into account in relating dose limits to MPC's (102). Table 5.3 indicates the maximum permissible concentrations of radionuclides in water available to the public.

TABLE 5.3

MAXIMUM PERMISSIBLE CONCENTRATIONS IN WATERS AVAILABLE TO THE PUBLIC

Radionuclide	MPDI (μCi/day)	MPC_w (μCi/ml)	MPC_{fw} (μCi/ml)
I-131	2.6×10^{-4}	3×10^{-7}*	3×10^{-7}
H-3	4.5	5.5×10^{-3}	5.5×10^{-3}
Cs-137	2.2×10^{-2}	1×10^{-5}	4×10^{-7}
Cs-134	1.4×10^{-2}	6×10^{-6}	3×10^{-7}
Sr-90	8.8×10^{-4}	4×10^{-7}	3×10^{-7}
Sr-89	2.2×10^{-2}	1×10^{-5}	7×10^{-6}
Co-60	0.11	5×10^{-5}	1.5×10^{-5}
Ba-La-140	4.4×10^{-2}	2×10^{-5}	6×10^{-6}
Ru-106	2.2×10^{-2}	1×10^{-5}	3×10^{-6}
Zr-Nb-95	0.13	6×10^{-5}	8×10^{-6}
Ce-144	2.2×10^{-2}	1×10^{-5}	3×10^{-6}
Zn-65	0.22	1×10^{-4}	3×10^{-6}
Fe-59	0.13	6×10^{-5}	2.5×10^{-6}

* — Critical group for I-131 is the infant; critical pathway is drinking water. Based on 1.5 rem to child's thyroid.

MPDI — maximum permissible daily intake

MPC_w — maximum permissible concentration in water used only for drinking

MPC_{fw} — maximum permissible concentration in water used for drinking and from which fish are caught for human consumption.

The average radionuclide concentrations in the station effluent should not exceed the MPC_{fw}'s given in Table 5.3. The averaging period is taken as one month rather than the ICRP recommended averaging period of one year, and no allowance is made for dilution of the cooling water discharge in the lake before it is used for drinking water or as an environment for uptake of radioactivity by the various fish species. Short term concentrations averaged over a few days should not exceed ten times the above values. For cases where several radionuclides are released, the MPC_{fw} for the most restrictive radionuclides, 3×10^{-7} Ci/ml, will be used as the average effluent MPC_{fw} for gross beta-gamma activity.

It must be noted that for the situation where an individual lives near a nuclear station he may receive a small radiation dose from a number of sources, e.g., inhalation, food consumption, drinking water. In this case, the total dose received must be less than the legal limit specified by the AECB.

5.3.1.2 Conventional Water Quality

The Federal government may enact legislation on discharges to water by virtue of its responsibility for international and interprovincial waters and fisheries. The Canada Water Act, 1970, provides for the establishment and operation of federal - provincial water quality management areas. The Act prohibits the disposal of waste, including heat, into water in any given management area except in quantities under conditions prescribed by the regulations. No regulations concerning thermal discharges have been made under the Act to date.

A 1970 amendment to the Fisheries Act, 1952, prohibits the deposition of any wastes in waters, including heat, which will degrade the water quality. Under this Act, the Department of Fisheries and Forestry may enquire into a company's plans for expansion and can demand modifications to its anti-pollution measures if considered necessary to protect the fisheries waters.

Disposal of dredgings in the lake falls under the provisions of the Navigable Waters Protection Act, 1970, which is enforced by the Federal Department of Transport. This Department now refers an application back to the Provincial Ministry of the Environment and the Provincial Ministry of Natural Resources to determine if any dumping procedure will have an adverse environmental impact. These two provincial Ministries provide an assessment to the Department of Transport before a license to dredge and dump is issued.

5.3.2 Provincial

The main body of provincial legislation for controlling water quality and biological effects is contained in the Ontario Water Resources Act. This Act gives the Ministry of the Environment the authority to supervise all surface and ground waters in Ontario. With respect to discharges, Section 30 states:

> "Under sections 31, 32, 34 and 36, the quality of water shall be deemed impaired if, notwithstanding that the quality of the water is not or may not become impaired, the material deposited or discharged or caused or permitted to be deposited or discharged or any derivative of such material causes or may cause injury to any person, animal, bird or other living thing as a result of the use or consumption of any plant, fish or other living matter or thing in the water or in the soil in contact with the water."

The Ministry of the Environment outlines its criteria in the publication - "Guidelines and Criteria for Water Quality Management in Ontario". These guidelines and criteria do not have force of law, but there are legal procedures under the Act for enforcing compliance. In addition to adhering to these objectives, Ontario Hydro consults with the Ministry of the Environment on specific items concerning individual stations. These include:

(i) The maximum allowable temperature rise between intake and discharge in the condenser cooling water. At existing stations under construction this has been 15F° for a station on Lake Erie and 20F° for the remaining Great Lakes.

(ii) The volume of cooling water to be used including that used for any tempering.

(iii) The area of the receiving body to be occupied by the thermal plume.

(iv) Water quality with respect to possible biological changes or influences.

(v) The winds and currents in the area which may influence the movement of the heated discharge.

(vi) Miscellaneous discharges, e.g. from the water treatment plant, boiler blowdown, and site drainage.

(vii) Water quality during dredging and dumping operations.

(viii) Batch releases of boiler treatment chemicals during the commissioning period.

The Ministry of Natural Resources can enforce the Lakes and Rivers Improvement Act and some provisions of the Federal Fisheries Act within the province. In practice, there is consultation between the Ministry of the Environment and the Ministry of Natural Resources, both of which have concern over the effects of discharges to the aquatic environment.

5.3.3 International

5.3.3.1 International Joint Commission - Radiological Aspects

The International Joint Commission (IJC) is a body which investigates, recommends and attempts to co-ordinate monitoring and surveillance activities on the quality of the boundary waters shared by the United States and Canada. The IJC discharges its function under the Boundary Waters Treaty of 1909. Proposals made for specific objectives regarding radioactivity levels in receiving waters include the following:

> "Elimination of radioactive materials to the extent necessary to prevent harmful effects on health. Pending the adoption of more stringent limits, in no event is gross beta activity to exceed 1000 pCi/l, radium-226 to exceed 3 pCi/l and strontium-90 to exceed 10 pCi/l" (97).

These recommendations are being revised and extended, and have been included by the Ministry of the Environment in its publication "Guidelines and Criteria for Water Quality Management in Ontario".

5.3.3.2 International: Conventional Water Quality

Proposals for water quality objectives were issued in 1970 by the International Joint

Commission (IJC), for lakes Erie, Ontario, the International Section of the St. Lawrence River and the connecting channels of the Great Lakes. In these proposals, the objective is that no heat discharge should be allowed which would adversely affect any local or general use of these waters. The IJC recommended that its programs and measures to achieve its objectives be agreed to by the Governments of Canada and the United States. It also recommended that appropriate Government agencies be involved in site selection and consulted in the design of thermal plants in order to minimize any adverse effects of temperature changes in the receiving waters. The IJC further suggested an extension of its existing authority to promote the implementation of its objectives.

There has been recent formal agreement between the Governments of Canada and the United States to give certain of the IJC proposals force of law.

5.4 SOLID WASTES

5.4.1 Radioactive Solid Wastes

The Atomic Energy Control Act contains regulations which govern the safe handling and transportation of radioactive materials, but there are no specific regulations governing the disposal of radioactive waste, although waste management practices have been reviewed and authorized by the AECB. Ontario Hydro has developed a set of waste management regulations for inclusion in the Ontario Hydro Radiation Protection Regulations. The basic philosophy of the regulations is summarized by the first of the waste management principles, namely:

> "All radioactive wastes shall be managed such that the public, its environment, and its resources are protected against hazard".

Further principles regarding radioactive waste disposal are "Facilities intended for storage of radioactive waste shall be designed to prevent radionuclide releases to the environment" and "Radiation exposure to individual members of the public resulting from the operation of the waste management area shall not exceed... (the maximum dose limit specified by the AECB in Table 5.1)."

Once a suitable site for a radioactive waste management area has been found, and before any construction can begin, plans for the site must be submitted to the AECB for its approval. A submission has been made to the AECB (30) outlining the design description of the Bruce Nuclear Power Development Radioactive Waste Management Area. When the AECB is satisfied that the site is suitable and that all appropriate measures have been taken to ensure that the general public and the environment are adequately protected, a construction permit will be issued. In order to operate the site, the AECB must issue an operating licence which is renewable at intervals provided satisfactory operating standards and environmental monitoring are maintained.

5.4.2 Non-Radioactive Conventional Solid Wastes

Collecting, transporting, processing and disposal of solid wastes during construction and operation are controlled by the provisions of the Environmental Protection Act, 1971. The two types of Certificates of Approval issued by the Waste Management Branch are for Waste Management Systems and Waste Disposal Sites.

A Waste Management System Certificate of Approval is required for the collecting, transporting, processing and disposal of wastes. This Certificate of Approval is not required

if Ontario Hydro uses its own vehicles on the property but is required if public roads, or if rented property is used. If handling is carried out by a contractor, he must take out the Certificate of Approval.

A Waste Disposal Site Certificate of Approval is required for each property where there is a disposal site. Waste from trash racks and on-site ash disposal, and sewage lagoon residues require a Waste Disposal Site Certificate of Approval. For off-site disposal, a Waste Management System Certificate of Approval is also required. Oil disposal on roads requires a Waste Management System Certificate of Approval and the locations of the intended disposal areas need to be stated.

Expansion of a system or site requires further application and hearings. The Certificates of Approval for a Waste Disposal Site or a Waste Management System expire one year after the approval date and must then be renewed.

Floating material removed by the travelling screens should not be returned to the water body but should be disposed of at an approved location. The Ministry of the Environment provides a water-use permit based on this requirement. In addition, under the provisions of the Environmental Protection Act, disposal of trash rack material must have a Certificate of Approval for the particular solid waste disposal system to be used. However, under the Federal Fisheries Act, the Provincial Ministry of Natural Resources is empowered to investigate cases where fish are removed from the water body, the Ministry's main concern being that fish should be returned in an unharmed condition.

5.5 NOISE

There are no definite medical or engineering procedures in existence as yet that can formulate the maximum permissible noise levels in industry or power generating stations. Loss of hearing, which is perhaps the only widely recognized criterion at present, has been used by industry to establish some upper limits for noise levels. For an eight hour a day exposure, The Occupational Safety and Health Act, 1970, in the United States has set an upper limit at 90 dBA. For 10-20 years of exposure, the risk factor quoted at these noise levels by different authorities varies from 7 to 17%. Ontario Hydro has set 85 dBA as a target for the upper limit of noise levels at all locations occupied by personnel inside power generating stations.

Noise emanating from the industry to the community is already receiving much attention. Although there is no unanimous agreement on the permissible noise levels at the industry-community property line, it is most probable that the upper limits as set by future legislation would be between 40 and 50 dBA.

5.6 LAND USE ZONING

5.6.1 Site

Ontario Hydro has sufficient land for construction of the proposed station. The property is zoned industrial and no further formal application need be submitted to the local Planning Board.

5.6.2 Transmission Line Egress

The existing 500-foot wide Ontario Hydro owned egress has two 230 kV double-circuit lines

constructed on each side of the egress path, with provision for two 230 kV double-circuit lines to go in between.

No new aquisition of property will be required. The line egress will be on Ontario Hydro owned land.

5.7 INFORMING THE PUBLIC

Ontario Hydro intends to make a public announcement and solicit the views of the public while the project is in the preliminary phase and before it is committed.

6.0 EXISTING ENVIRONMENT

The data presented in this section describes the environment as it now exists with Pickering G.S.-A operating, and prior to the construction and operation of the proposed Pickering G.S.-B.

6.1 AIR

6.1.1 Quality

The proposed site is in an area containing residential, commercial, light and some heavy industrial development and farming. Pickering G.S.-B is proposed for a site immediately to the east of the existing Pickering G.S.-A.

Documentation of conventional emissions, such as that due to light industry, normal urban growth and auto emissions is limited. However, air quality is expected to be normally good due to the absence of any local large industrial emitters.

Radioactivity measurements in the vicinity of the existing Pickering G.S.-A have been arried out independently by Ontario Hydro, by the Radiation Protection Service of the Ontario Department of Health, and by the Radiation Protection Division of the Department of National Health and Welfare. The following paragraphs summarize the data obtained by each of the above groups.

6.1.1.1 Measurements by Ontario Hydro

(i) External Gamma Background

Figure 6 presents the data gathered at three locations in the vicinity of the station. The readings were taken from January 1971 to July 1973.

(ii) Airborne Tritium

Table 6.1 lists the "Tritium in Air Data at the Site Boundary" for the period April 1971 to August 1973.

6.1.1.2 Measurements by the Radiation Protection Service, Ontario Department of Health

The gross beta activity in air filter samples collected at various locations from November 1970 to July 1973 are presented in Table 6.2.

6.1.1.3 Measurements by the Radiation Protection Division, Department of National Health and Welfare

The airborne tritium concentrations for various locations near the Pickering site, obtained from May 1971 to December 1972 are presented in Table 6.3.

The background radiation level in the Pickering vicinity prior to operation of Units 5-8 is determined from data presented in Fig. 6. The measured mean gamma background activity is between 5 and 6 microrem per hour. From the data obtained over approximately two years of operation, there appears to have been no detectable increase in the background gamma

radiation level. It is difficult to determine if any of the measured radiation is due to operation of Pickering G.S.-A. Naturally occurring gamma radiation at location 6 shows a seasonal variation of 1-2 microrem per hour and any contribution from the station operation would appear to be less than this natural variability. Several more years of data collection will be required to determine the trend of background levels in the area and whether they are affected by radioactive emissions from the existing and proposed stations.

Meeting the design and operating targets would ensure that the background radiation levels at the Pickering site would not be appreciably different from present levels.

6.1.2 Quality - Non-Radiological

Air quality data are not available for the immediate area of the station. However, since the area is mainly residential, and there are no large industrial sources in the area, it is expected to be good.

On site, the only sources of non-radioactive atmospheric emissions are the existing gas turbines. The turbines are fired by light distillate oil (0.5% sulphur), and operate a total of approximately 468 hours/year, mainly for backup to provide black start capabilities. This includes regular use for testing purposes, and occasionally to provide peaking capacity.

6.1.3 Meteorology

6.1.3.1 General

The local meteorological conditions must be known in order to determine plant design parameters and operating conditions required to diffuse and disperse atmospheric emissions from the station so that the resulting air quality in the vicinity meets government regulations and minimizes environmental effects.

Data required to predict the dispersion of plant atmospheric emissions include wind, temperature, Pasquill atmospheric stability classes, temperature lapse rates and other specific conditions characteristic of the site area. Data on prevailing ground level winds, climatology and stability classes are documented for the general area, but specific site data on atmospheric conditions such as vertical temperature lapse rates, nocturnal and seasonal oversions, lake breeze effect and mixing layer depths are lacking.

6.1.3.2 Building Design Data

A set of recommended values of design weather data for the area is outlined in the Canadian Building Code "Climatic Information For Building Design In Canada, 1965"(22).

Criteria	Data	
1.	Winter design temperature: January 2-1/2% minus 1F°	
2.	Winter design temperature: January 1% minus 4F°	
3.	Annual degree-days below 65°F:	7100
4.	Maximum 15-minute rainfall:	1.1 in
5.	Maximum 1-day rainfall:	4 in

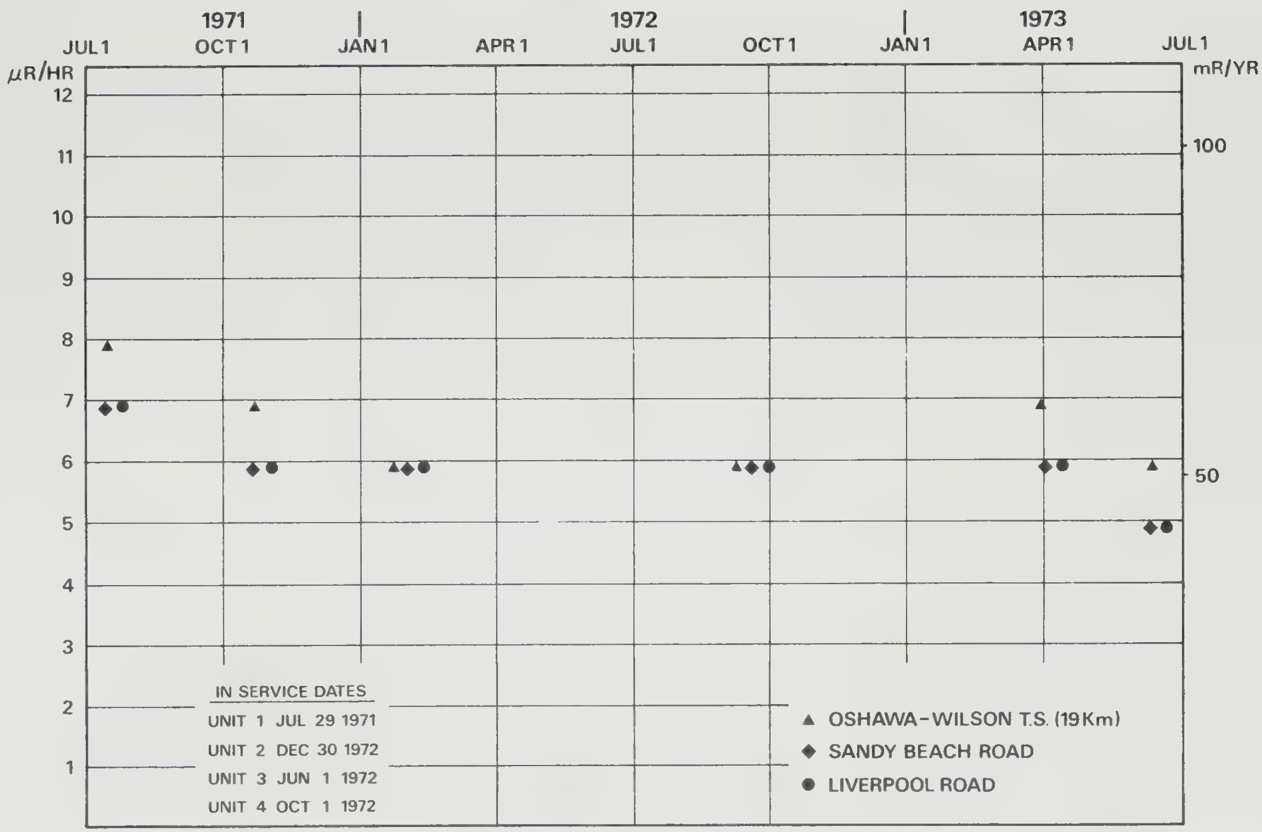


FIGURE 6 EXTERNAL GAMMA RADIATION BACKGROUND

6. Annual total precipitation: 32 in

7. Snow load, horizontal roof: 34 lb/ft^2

8. Wind load: 21 lb/ft^2

TABLE 6.1

TRITIUM IN AIR DATA AT SITE BOUNDARY

Sampling Period		Airborne Tritium Concentration (pCi/m^3)					
		Brock Rd. South	Sandy Beach Rd.	Alderwood Place	Liverpool Rd.	Highway 7	Montgomery Rd.
Apr	1971	16	24	12	33	–	
May	1971	31	10	10	6	–	
Jun	1971	182	39	82	63	–	
Aug	1971	58	25	52	20	–	
Sep	1971	137	23	57	79	63	
Oct	1971	33	48	111	16	37	
Nov	1971	129	82	189	49	49	
Dec	1971	139	444	247	441	207	
Jan	1972	280	26	146	206	135	
Feb	1972	393	268	405	218	–	
Mar	1972	174	107	359	117	304	
Apr	1972	100	81	37	154	255	
May	1973	315	187		300	168	310
Jun	1973			SAMPLES LOST			
Jul	1973	100	139		81	15	155
Aug	1973	105	9		69	18	328

Notes:

1. The reference location at Hwy. No. 7 is about 10 km from the site. The other locations are about 1 km from the site.

2. Higher levels from December 1971 to April 1972 are high due to contamination of the low level counting equipment.

3. No data are available for the period May 1972 – April 1973 due to laboratory relocation and Ontario Hydro strike.

4. Sampling locations were moved to permanent locations prior to May 1973 (Fig. 4). There is now no monitor at Alderwood Place.

5. The MPC_a for the public is 3×10^5 pCi/m^3.

$$1 \text{ pCi} = 10^{-12} \text{ Ci}$$

TABLE 6.2

RADIOACTIVITY COLLECTED ON AIR FILTER SAMPLES

GROSS BETA ACTIVITY (pCi/m^3)

Sampling Date	Pickering (Fire Hall)	Pickering (School)	Pickering (Farm)	Provincial Average
Nov 29, 1970	0.04	–	0.05	0.09
Dec 15	0.10	–	0.05	0.09
Dec 31	0.14	0.11	0.08	0.16
Jan 8, 1971	0.08	0.06	0.07	
Jan 16	0.08	0.09	0.08	0.09
Feb 1	0.09	0.07	–	0.11
Feb 17	0.07	–	0.09	–
Mar 13	0.25	0.25	0.25	0.19
Mar 29	0.07	–	0.11	0.22
Apr 30	0.38	0.26	0.30	0.28
May 16	0.91	0.74	0.87	0.76
Jun 9	0.50	0.48	0.46	0.59
Jun 25	0.92	0.88	0.95	0.61
Jul 27	0.17	0.27	0.19	0.43
Aug 12	0.26	0.24	0.26	0.39
Sep 13	0.04	0.10	0.12	0.14
Oct 15	0.12	0.14	0.13	0.20
Nov 8	0.01	0.02	0.01	0.08
Nov 24	0.11	0.08	0.09	0.07
Dec 10	0.04	0.05	0.05	0.06
Dec 26	0.04	–	0.07	0.05
Jan 3, 1972	0.06	0.04	0.05	0.07
Jan 19, 1972	0.13	0.09	0.15	0.08
Feb 4	0.003	0.06	0.06	0.09
Feb 20	0.08	0.12	0.12	0.11
Mar 7	0.09	0.12	0.13	0.09
Mar 23	0.06	0.05	–	0.07
Apr 8	0.08	0.08	0.08	0.07
Apr 24	0.02	0.06	0.02	0.07
May 10	0.13	0.13	0.14	0.107
May 26	0.13	0.21	0.16	0.12
Jun 3	0.11	0.10	0.19	0.17
Jun 19	0.08	0.10	0.08	0.08
Jul 5	0.03	0.16	0.25	0.16
Jul 21	–	0.07	0.07	0.09
Aug 6	–	0.01	0.09	0.09
Aug 22	0.11	–	0.10	0.08
Sep 7	0.09	–	0.07	0.07
Sep 23	0.01	0.04	0.02	–
Oct 12	–	0.04	0.01	–
Oct 27	0.06	–	0.08	–
Nov 7	0.04	–	0.03	–
Nov 20	0.06	–	0.06	–

TABLE 6.2 (Cont'd.)

RADIOACTIVITY COLLECTED ON AIR FILTER SAMPLES

GROSS BETA ACTIVITY (pCi/m^3)

Sampling Date	Pickering (Fire Hall)	Pickering (School)	Pickering (Farm)	Provincial Average
Dec 10	0.05	–	0.09	–
Dec 31	0.04	–	0.10	–
Jan 6, 1973	0.05	–	–	–
Jan 21	0.04	–	0.07	–
Feb 11	0.06	0.03	0.08	–
Feb 25	0.05	0.04	0.10	–
Mar 11	0.04	–	0.05	–
Mar 25	0.03	–	0.07	–
Apr 8	0.03	–	0.05	–
Apr 22	0.02	0.07	0.04	–
May 6	0.04	0.05	0.03	–
May 27	0.02	–	0.02	–
Jun 3	0.03	0.05	0.04	–
Jun 24	0.03	0.04	–	–
Jul 14	–	0.04	–	–

6.1.3.3 Winds

Regular reporting of on-site wind data began in late 1972. Until such time as valid statistical wind direction and speed data are available, on site wind data from the Ontario Hydro survey at Wesleyville (23) will be used (Table 6.4). Wind data pertinent to the site are summarized (24) for

(a) Toronto International (30 miles) and Toronto Island (21 miles),

(b) Trenton (60 miles),

(c) Cobourg (40 miles) and

(d) Toronto Agincourt (12 miles northwest).

Agincourt and Toronto Island, though in close proximity to Pickering, are considered to differ from the site due to city effects. Toronto International Airport is well inland and would not be affected by the lake breeze to any extent. Agreement between the Wesleyville data and Trenton is reasonably good.

Significant discrepancies are indicated between the stations. These are more than likely due to differences in location and time sampling periods. Based on the data, the predominant wind would come from the northwest/southwest sector.

TABLE 6.3

AIRBORNE TRITIUM DATA
NEAR PICKERING SITE

Concentration (pCi/m^3)**

Sampling Location*	1	2	3	4	5	6
Period						
May 1971	26	112	ND	33	ND	–
Jun 1971	52	18	45	17	ND	–
Jul 1971	264	61	27	146	189	–
Sep 1971	15	ND	34	9	125	–
Oct 1971	109	31	13	13	35	–
Nov 1971	8	8	ND	4	65	–
Dec 1971	11	46	7	2	24	–
Jan 1972	5	8	6	8	12	71
Feb 1972	27	21	ND	7	17	6
Mar 1972	7	8	ND	7	28	ND
Apr 1972	14	6	7	29	59	ND
May 1972	44***	8	101	23	46***	–
Jun 1972	44***	–	70	53	46***	–
Jul 1972	–	55	98	641	200	–
Aug 1972	121	3	54	469	198	–
Sep 1972	–	–	102	144	104	–
Oct 1972	23	32	14	14	39	–
Nov 1972	–	47	5	ND	119	–
Dec 1972	4	ND	ND	10	31	–

Notes: ND = Not detectable

*Location 6 is about 10 km from the site Other locations are about 2 or 3 km from the site.

**MPC_a for members of the public (inhalation) = $3 \times 10^5 pCi/m^3$

***May and June samples collected together

When more suitable long term data are available, local wind conditions can be assessed more accurately. For the purpose of this study, on-site wind data from the Ontario Hydro survey now being carried out at the Wesleyville site is considered to be most representative. Based on eight directions, present data indicate the predominant wind to be from the west, approximately 21% of the time.

The lake breeze studied at Douglas Point (26) and found to occur 70% and 80% of the daytime hours during the spring and summer respectively, is expected to occur at the Pickering site. Off-lake winds actuated by the temperature difference between the air over land and water cause a movement of local air masses. The land breeze is usually unaffected by the normal local geostrophic winds. Air from the lake passes over the land, rises and returns over the lake. Interpretation of this work indicates the probable continuous recirculation of an air mass from the lake over land and back throughout the day due to the lake breeze effect. The lake breeze effect on Lake Michigan has been studied and recorded (27).

TABLE 6.4

WIND DIRECTION AND FREQUENCIES - WESLEYVILLE SITE

Location	Period	N	NE	E	SE	S	SW	W	NW	Calm
Wesleyville Site	1970-72	14	17	9	3	5	17	21	14	–
Trenton	1955-56	11	11	7	4	7	21	15	15	10
Cobourg	1939-50	12	9	16	9	4	5	21	23	1
Toronto Island	1955-66	6	11	14	5	8	20	15	21	–
Toronto International	1955-66	17	6	7	8	10	15	18	14	5
Toronto Agincourt	1955-66	8	9	13	5	6	18	16	24	1

TABLE 6.5

WIND SPEEDS - WESLEYVILLE SITE

Location	Period	N	NE	E	SE	S	SW	W	NW
Trenton	1955-66	9.2	8.9	8.9	9.2	9.5	12.0	12.7	12.0
Cobourg	1939-50	6.6	8.4	9.7	12.7	10.0	15.1	13.1	9.0
Toronto Island	1955-66	7.9	11.0	11.1	8.9	9.6	11.5	10.4	10.9
Toronto International	1955-66	8.9	7.5	10.1	8.0	8.0	11.5	11.8	10.6
Toronto Agincourt	1955-66	6.8	8.4	10.6	7.7	8.1	11.4	9.0	9.6

6.1.3.4 Atmospheric Stability

The diffusion and dispersion characteristics of any stack gaseous releases from Pickering G.S. are determined by the stability of the atmosphere. The two methods most commonly used to define stability are the Pasquill stability categories and the temperature lapse rates. Atmospheric stability defines the potential of the atmosphere to disperse airborne emissions.

Pasquill (66) proposed six stability categories, "A" (very unstable) through "F" (stable), which are used to aid in the prediction of dispersion patterns. Pasquill categories are determined by wind speed, incoming solar radiation and cloud cover. Since meteorological reporting stations regularly log this type of data, the frequency distribution of Pasquill stability categories for off-site meteorological reporting stations are available, i.e., Toronto International Airport and Canadian Forces Base Trenton. Trenton is assumed to experience conditions which are most representative of the Pickering site.

The frequency distribution of the categories for the Trenton area is summarized following. Pasquill stability categories are useful first approximations for estimating diffusion. The method of classification by Pasquill only records nighttime inversions.

Stability Classes	% Annual Frequency Trenton	Toronto Int. Airport
A	4	6
B	8	11
C	15	16
D	54	48
E	7	9
F	12	10

Inversions other than nocturnal, either lake induced or seasonal, actually occur during periods represented by C and D categories, but detailed data on occurrences are not available. The lake induced inversion is largely restricted to that period of the year when the lake is cooler than the land, usually mid-March to mid-July. The seasonal inversion is common to the fall of the year and is caused by warm stationary climatic conditions characterized by poor dispersion, low wind speeds and no precipitation. This condition may last for a number of days and has been responsible for numerous episodes, for example, that occurring during the Grey Cup, 1962.

Other seasonal inversions occur throughout the year as various frontal weather systems pass through the area.

Temperature lapse rates indicate the change in temperature with height and are a more definitive method of defining atmospheric stability. A dry adiabatic lapse rate, sometimes called neutral condition, occurs when the temperature decreases at a rate of 1C° per 100 meters. Inversions are characterized by temperature increase with height. Data required to define local conditions and evaluate (a) temperature lapse rates, (b) inversion frequency, (c) mixing layer depths, (d) lake breeze effect and area, and (e) stagnation occurrences are limited for this site. Therefore, data acquired over the years from other locations on the Great Lakes shores, in addition to data acquired on the site, will be applied to evaluate dispersion of atmospheric emissions. This includes work at Douglas Point on Lake Huron (26), Lakeview G.S. on Lake Ontario (94), Bowmanville on Lake Ontario (95), and a Toronto lakeshore site (28).

In the absence of actual dispersion measurements, ground level concentrations resulting from the diffusion of gaseous emissions in the atmosphere are calculated by mathematical models. At a lakeshore site such as Pickering, three models may be used to describe atmospheric conditions that could occur at the site. These are the coning, fumigation and limited mixing models. The coning model represents conditions that occur most of the time. Diffusion calculations are made for each of the Pasquill stability categories to determine resulting ground level concentrations under unstable, neutral and stable atmospheric conditions.

Due to low water temperatures and high air temperatures during the spring and summer, an inversion condition will occur offshore during certain periods. The temperature difference between land and water or normal pressure gradients cause the stable air mass to move in overland. As the air mass passes overland, it is warmed up from the ground by solar radiation, resulting in an unstable temperature lapse rate (good mixing conditions) below the inversion. This results in the classic fumigation condition which produces ground level concentrations not considered in the general coning model. During such a condition, ground level concentrations could reach higher levels. The nocturnal inversion is caused by the rapid

cooling of air near the ground producing a ground based inversion. During the breakup of this inversion, which starts during the early morning as radiation from the sun warms the ground first, the classic fumigation condition may also occur.

During limited mixing conditions, plume dispersion is inhibited due to an elevated inversion above the site (i.e., base of inversion not at ground level), resulting in limited upward diffusion. Depending on the mixing height (or inversion base height), the resulting ground level concentrations will exceed the normal coning model values. Data are not yet available on the statistical distribution of mixing heights in the site area. Maximum ground level concentrations are estimated to be between values derived for the coning and fumigation models depending on mixing height.

At the Wesleyville site inversions were shown to occur for 80% of the days studied between June and September 1972. These inversions existed below 200 meters, but on occasion extended beyond this height. Several examples of the lake breeze effect were studied (96).

All observations were during the daytime hours. Table 6.6 outlines data accumulated for Scarborough on the percentage frequency of inversion occurrence of ground-based or elevated inversions. The elevated inversions recorded were below 3000 feet.

TABLE 6.6

PERCENTAGE ANNUAL FREQUENCY OF OCCURRENCE OF INVERSIONS AT SCARBOROUGH (28)

Lake to Land Wind	% Elevated Inversions	% Ground-based Inversions	
Dec-Mar	58	10	68
Apr-Aug	23	30	53
Sep-Nov	50	11	61
Land to Lake Wind			
Dec-Mar	30	7	37
Apr-Aug	18	12	30
Sep-Nov	20	13	33
All Wind Directions			
Dec-Mar	41	8	49
Apr-Aug	21	23	44
Sep-Nov	34	12	46

Table 6.6 shows that the daytime inversions are more prevalent with off-lake than with off-land winds. In the case of ground based inversions, the difference is small, and there is little variation except in the April-August period when the percentage of off-lake winds is over twice the frequency of off-land winds.

Table 6.6 shows that the daytime inversions are more prevalent with off-lake than with off-land winds. In the case of ground based inversions, the difference is small, and there is little variation except in the April-August period when the percentage of off-lake winds is over twice the frequency of off-land winds.

For elevated inversions based above the ground and below 3,000 feet, there is little difference between off-land and off-water calculations, in April-August. During the remainder of the year, however, the frequency of off-water inversions doubles, probably because warm frontal inversions occur with south-easterly flows (28).

During potentially poor dispersion conditions, station emissions will be controlled so that ground level concentrations are within regulating limits.

6.2 WATER

Lake Ontario, the most eastern of the Great Lakes has a shoreline length of 726 miles and a surface area of 7,340 square miles (10). The surface of the lake averages 245 feet above mean sea level. Its greatest depth is 840 feet; the average depth 300 feet (10). The total volume of the lake is 390 cubic miles. Lake Ontario is a deep lake with approximately 85% of the water mass below the epilimnion.

The major in-flow (about 80%) is from Lake Erie via the Niagara River, which discharges an average flow of approximately 200,000 cubic feet per second into Lake Ontario.

Lake Ontario has spring and fall turnovers, a maximum surface temperature of 77°F in summer (4), and a pronounced thermal and chemical stratification. A warm, readily circulating upper layer (epilimnion) and a cold undisturbed lower layer (hypolimnion) develop with a zone of rapid temperature change (thermocline or metalimnion) between the two. If the epilimnion and hypolimnion do not mix, nutrients released by decay processes in and near the bottom sediments remain trapped in the bottom waters during summer. Seiche action can lead to sudden rapid temperature changes in the inshore water area (64).

In the fall, the upper waters cool and the lake becomes essentially vertically isothermal; in the winter it does not freeze over except near shore and in bay areas at the eastern end of the lake.

In the spring, preferential heating of the shallow inshore waters produces a "thermal bar". During its existence, nutrients carried into the lake by streams may become trapped for short periods of time along the shoreline. The thermal bar mechanism is transient in nature and has been observed at one Lake Michigan plant site moving off-shore, toward the center of the lake, at velocities from 0.1 to 0.5 miles/day (103). While the thermal bar mechanism inhibits horizontal mixing near the surface of the lake, good vertical mixing has been observed in the region of convergence. Stratification of the lake does not separate the near-shore water from the main lake. While it may inhibit mixing with the deeper lake water, ambient currents continue to move quantities of water into the area (103).

6.2.1 Quality

Monitoring of water quality off the Pickering site has been carried out by various groups. Periodic surveys by the Great Lakes Institute (10), and water quality sampling in the Pickering area by the Ministry of the Environment have been combined with Ontario Hydro results to give a composite water quality analysis (Table 6.7).

TABLE 6.7

WATER ANALYSIS

pH 24° C	8.2
Colour (hazen units)	5.0
Turbidity (SiO_2)	15.0
Specific Conductivity at 25° C	360 micromhos/cm
Saturation Index at 24° C	+0.41
Saturation Index at 70° C	+0.92
Water Temperature	33-75° F
The following are in milligrams per litre (mg/l)	
Carbonate	3
Bicarbonate	134
Chloride	32
Sulphate	29
Nitrate	1
Calcium	43
Magnesium	11
Sodium	16
Potasium	2
Iron	0.3
Silica	1.0
Oxygen Consumed	2.4
Suspended Solids at 105° C	24
Dissolved Solids at 105° C	236
Dissolved Solids at 600°C	146

Radioactivity measurements of the station condenser cooling water effluent and of the water in the vicinity of drinking water supplies have been made by Ontario Hydro (Tables 6.8 and 6.9), Ontario Department of Health (Table 6.10) and the Department of National Health and Welfare (Table 6.11). MPC_w for members of the public are 300 pCi/1 for gross beta and 5500 nCi/1 for tritium.

Since 1968, the Ministry of the Environment has monitored water quality at three stations near Pickering (65). Dissolved oxygen levels are normally high during the winter, but may decrease with depth to less saturated levels in the summer. Dissolved oxygen levels peak at approximately 14 ppm near the surface inshore in the spring, and gradually decrease to 7 ppm in the Frenchman Bay area in September. The lowest saturation level was 71% in Frenchman Bay in October at the 6-foot depth (21). This is well above a desirable lower limit of 5 ppm (97). Sampling in and outside the thermal plume area in 1971 and 1972 has not indicated any change in dissolved oxygen levels. (37, 107,) Dissolved oxygen levels in the lake offshore from Pickering vary with season and depth from 9-14 ppm (4, 5, 6).

Phosphate and nitrate levels have remained fairly constant in the outfall area during 1968-1972, indicating no increase in nutrient levels (36). International Joint Commission surveys have shown the nutrient levels in the lake proper to be increasing over the last forty years (12). Surveys by the Canada Centre for Inland Waters during 1969 report seasonal averages of 0.04 mg/l total phosphate and 0.1 mg/l nitrate (4,6).

TABLE 6.8

RADIONUCLIDE CONCENTRATIONS IN WATER
MEASURED BY ONTARIO HYDRO
GENERAL SITE AREA

Date	Sample Location	** Tritium (nCi/1)	** Gross Beta (pCi/1)
Apr 8, 1970	Discharge Channel Area	0.5*	
Apr 8, 1970	Frenchman Bay, East Side	0.49*	
Apr 8, 1970	Pickering Township Drinking Water Supply	0.51*	
Mar 1971	Pickering Township Drinking Water Supply	<1	5
Apr 1971	Pickering Township Drinking Water Supply	<1	9
May 1971	Pickering Township Drinking Water Supply	<1	10
Jun 1971	Pickering Township Drinking Water Supply	Sample Contaminated	6
Aug 1971	Pickering Township Drinking Water Supply	Sample Contaminated	5
Sep 1971	Pickering Township Drinking Water Supply	Sample Contaminated	5
Oct 1971	Pickering Township Drinking Water Supply	<1	4
Nov 1971	Pickering Township Drinking Water Supply	1.2	6
Dec 1971	Pickering Township Drinking Water Supply	<1	3
Jan 1972	Pickering Township Drinking Water Supply	4.7	6
Feb 1972	Pickering Township Drinking Water Supply	<1	
Mar 1972	Pickering Township Drinking Water Supply	<1	5
Apr 1972	Pickering Township Drinking Water Supply	2	Counter out of Service
May 1972	Pickering Township Drinking Water Supply	<1	Counter out of Service

* Sample enriched by electrolysis prior to counting.

** Note: MPC_w's for members of the public are:
Gross Beta — 300 pCi/1
Tritium — 5500 nCi/1

Specific conductivity measurements in the inshore discharge area vary with season and average approximately 340 mho/cm^{-1}. Offshore, specific conductivity varies with season, peaking at approximately 320 mho/cm^{-1} in the late fall lake turnover period and declining to 260 mho/cm^{-1} in the summer. Suspended solids are normally in the 22 ppm range. Strong winds cause turbulence which suspends silt, and readings of 150 ppm are not uncommon during these periods. Extremes of 700 ppm suspended solids have occurred during early winter storms (4, 5, 6).

Data from Tables 6.8 through 6.11 suggest that the operation of Pickering G.S.-A has had some effect on the levels of radioactivity in water. In general, the feed to the upgrading plant contains radioactive tritium associated with the D_2O. Small amounts of tritium are therefore

TABLE 6.9

CALCULATED RADIOACTIVITY IN COOLING WATER DISCHARGE (1972)

Month	Activity Pumped Out of Dispersal Tanks		Average CCW	Calculated Concentrations**	
	H-3 (Ci)	Gross β (Ci)	Flow (litres/month)	H-3 nCi/1	Gross β pCi/1
Jan	59.2	0.025	0.127×10^{12}	0.465	0.196
Feb	66.1	1.15	0.118×10^{12}	0.557	9.6
Mar	88	0.2	0.114×10^{12}	0.772	1.76
Apr	170	0.36	0.148×10^{12}	1.15	2.4
May	60.8	0.048	0.144×10^{12}	0.422	0.333
Jun	6.2	0.078	0.159×10^{12}	0.057	0.490
Jul *	5.8	0.011	–	–	–
Aug *	26.8	0.32	–	–	–
Sep *	44.6	0.034	–	–	–
Oct *	63.7	0.049	–	–	–
Nov	182	0.05	0.178×10^{12}	1.02	0.280
Dec	16.7	0.015	0.165×10^{12}	0.101	0.09
Composite Jan-June 1973	152/month avg.	0.029/ month avg.	0.138×10^{12}	1.1	0.21

* Station shutdown July to October 1972 due to strike

** MPC_W for members of the public are:

Gross Beta – 300 pCi/1
Tritium – 5500 nCi/1

Includes activity released from Lummus heavy water upgrading plant.

TABLE 6.10

RADIONUCLIDE CONCENTRATIONS IN WATER
RADIATION PROTECTION SERVICE
ONTARIO DEPARTMENT OF HEALTH

Date	Sampling Location	Undissolved Solids Alpha (pCi/1)	Undissolved Solids Beta (pCi/1)	Dissolved Solids Alpha (pCi/1)	Dissolved Solids Beta (pCi/1)	Tritium (nCi/1)
Jun 14/70	Pickering G.S.-A Intake Point	0.1	0.9	0.3	7	–
Aug 26	Pickering Vicinity	1	1	1	6	–
Jun 17/71	1*	1	1	1	7	1.7
	2**	1	1	1	4	1.7
	2	1	1	1	6	1.7
Jul 5	1	1	1	1	4	1.7
	2	1	1	1	7	1.7
Aug 6	1	1	1	1	8	1.7
	2	1	2	1	6	1.7
Aug 30	1	1	1	1	6	1.7
	2	1	1	1	6	1.7
Sep 23	1	1	1	1	6	1.7
	2	1	1	1	5	1.7
Oct 18	1	1	1	1	4	1.7
	2	1	1	1	4	1.7
Nov 12	1	1	1	1	5	1.7
	2	1	1	1	9	1.7
Dec 7	1	1	1	1	5	1.7
	2	1	1	1	6	1.7
Dec 29	1	1	3	1	5	1.7
	2	1	1	1	5	1.7
Jan 7/72	1	1	2	1	3	1.7
Jan 21	1	1	1	1	5	1.7
	2	1	2	1	5	1.7
Feb 14	1	1	1	1	6	1.7
	2	1	1	1	5	1.7
Mar 10	1	1	1	1	5	1.7
	2	1	1	1	6	1.7
Apr 21	1	1	1	1	8	1.7
	2	1	1	1	8	1.7
Jul 17	1	1	1	1	8	1.7
	2	1	1	1	8	1.7
Aug 18	1	1	1	1	8	1.7
	2	1	1	1	8	1.7
Sep 11	1	1	1	1	12	1.7
	2	1	1	1	12	1.7

TABLE 6.10 (Cont'd.)

RADIONUCLIDE CONCENTRATIONS IN WATER
RADIATION PROTECTION SERVICE
ONTARIO DEPARTMENT OF HEALTH

Date	Sampling Location	Undissolved Solids Alpha (pCi/1)	Undissolved Solids Beta (pCi/1)	Dissolved Solids Alpha (pCi/1)	Dissolved Solids Beta (pCi/1)	Tritium (nCi/1)
Oct 13/72	1	1	1	1	8	1.7
	2	1	1	1	7	1.7
Nov 10	1	1	1	1	6	1.7
	2	1	1	1	5	1.7
Dec 14	1	1	2	1	5	1.7
	2	1	1	1	5	1.7
Jan 12/73	1	1	1	1	6	1.7
	2	1	1	2	9	1.7
Feb 12	1	1	1	1	6	1.7
	2	1	1	1	7	1.7
Mar 16	1	1	1	1	6	1.7
	2	1	2	1	7	1.7
Apr 13	1	1	1	1	7	1.7
	2	1	1	1	8	1.7
May 18	1	1	1	1	5	1.7
	2	1	1	1	6	1.7
Jun 18	1	1	1	1	7	1.7
	2	1	1	1	5	1.7
Jul 9	1	1	1	1	3	1.7
	2	1	1	1	2	1.7
Aug 10	1	1	1	1	3	1.7
	2	1	1	1	3	1.7

* Wm. A. Pamish Waterworks (Ajax)
** J.S. Scott Waterworks (Pickering)

N.B. Readings of 1 for alphas and betas and 1.7 for tritium represent lower detection limits for monitoring equipment. Counting standard for gross beta is Sr-90.

released in the discharged reject stream. A very large proportion of the tritium entering the distillation tower remains in the upgraded heavy water product. At present the upgrading plant releases about 1 Ci/day tritium, which is about 10% of the total release in station liquid effluents. Because there is adequate dilution of the reject stream before discharge, concentrations of tritium in the plant effluent are well below the 1 Ci/1 station licence limit. However, it is difficult to determine with the present data whether there is an actual change due to the station operation or if it is due to variability in naturally occurring background radiation. It is difficult to accurately measure these very low concentrations of radioactivity which are very small fractions of the maximum permissible levels. Meeting the design and operating targets (Section 3.3) for the existing station, will ensure that the levels of radioactivity will remain very small fractions of the allowable limits.

TABLE 6.11

RADIONUCLIDE CONCENTRATIONS IN DRINKING WATER
MEASUREMENTS BY THE
RADIATION PROTECTION DEPARTMENT
DEPARTMENT OF NATIONAL HEALTH AND WELFARE

Sampling Period	Sampling Location	Sr-89 (pCi/1)	Sr-90 (pCi/1)	Cs-137 (pCi/1)
Apr-Jun 1971	1 2	0.09 0.32	0.89 1.18	<10 <10
Jul-Sep 1971	1 2	0.05 0.02	0.79 0.70	0.12 0.06
Oct-Dec 1971	1 2 3	0.10 0.03 0.10	0.82 0.52 1.04	0.14 0.07 0.43
Jan-Mar 1972	1 2 3	0.03 0.01 0.06	0.87 0.82 0.94	0.35 0.39 0.22
Jul-Sep 1972	1 2 3	0.06 0.05 ND	0.98 0.77 1.40	0.12 0.17 0.08
Oct-Dec 1972	1 2 3	0.04 0.06 0.04	0.86 0.82 1.08	0.10 0.08 0.05

Sampling Location:

1 — Wm. A. Pamish Waterworks (Ajax)
2 — J.S. Scott Waterworks (Pickering)
3 — R.C. Harris Waterworks (Toronto)

Notes:

1. The Maximum Permissible Concentration (fish and water)

(MPC_{fw}'s) for members of the public are:

For Sr-89 — 7000 pCi/1
For Sr-90 — 300 pCi/1
For Cs-137 — 400 pCi/1

2. Cs-137 readings for April-June 1971 by gamma spectrometry.
Subsequent readings by radiochemical analysis.
Lower limit of detection by gamma spectrometry is 10 pCi/1.

6.2.1.1 Activity Uptake by Aquatic Biota

Sampling programs in cooperation with the Department of National Health and Welfare and the Ministry of the Environment have established a baseline for activity levels in fish, algae and benthic organisms. Tables 6.12 and 6.13 summarize available data from the above agencies. Values shown indicate activity content due to the uptake of residual fallout from atmospheric nuclear testing by the U.S.A. and the U.S.S.R. in the late 1950's and the early 1960's and more recent additions due to fall-out from the French and Chinese nuclear atmospheric testing programs. Sampling during post-operational periods has also been carried out.

6.2.2 Currents

Limited information on lake currents offshore from the Pickering site area was obtained by Ontario Hydro during the period May to November 1971 and 1972 using an in-situ recording current meter which was located at 26-foot depth in 46 feet of water about 5,500 feet offshore from Pickering G.S.

Ontario Hydro results from the recording meter indicated that about two-thirds of the time during the May to November period, the lake currents were in the east and west quadrants, i.e., along shore, and about equally divided between the two quadrants. The current pattern was generally variable in summer, but became persistent to the east and west quadrants in the fall. While the relationship between currents and wind was poor during June and July, it improved from August on, and in October and November the direction of both wind and currents agreed closely. Average and maximum current speeds recorded during the two periods were 0.25 fps and 0.90 fps respectively. These were lower than those recorded during the same period at other locations along the north shore of Lake Ontario. It appears that the confines of the bay and the irregular geometery of the shoreline tend to retard the movement of water in the Pickering area. From the results it may be concluded that summer currents are not a result of wind induced circulation alone, but that a combination of wind forces and internal oscillations may be responsible for the movement of water in this area. In the fall, however, the effect of wind appears predominant.

The above results are considered relevant only to currents at 26-foot depth about a mile ffshore. The pattern of currents in the surface zone and at other distances offshore is under study. Preliminary indications are that currents near shore would result primarily from wind forces.

The Ministry of the Environment studied currents in the Frenchman Bay area of Lake Ontario during 1968 (1). Two recording current meters were operated from June to August, 1968 in 42 feet of water at distances up to 8 feet and 15 feet from the bottom approximately one mile off shore. A maximum current of 21 centimeters per second (0.69 fps) was recorded and was significantly lower than results obtained by other current meter studies in adjacent areas and farther off shore (15). This appears to be a result of the shore geometry which reduced the currents in the area. Both the direction and persistence factors agree with results of other studies.

6.2.3 Temperatures

6.2.3.1 Ambient Lake Conditions

Water temperatures have been recorded at various locations offshore from the Pickering site by Ontario Hydro between May and November of 1970, before any of the nuclear units came into service, and during the same period in 1971 and 1972 when the first 3 units were being commissioned. In 1970, the maximum daily mean temperature recorded at 5-foot depth at

TABLE 6.12

ACTIVITY UPTAKE IN FISH

	AUG. 18, 1971			NOV 24, 1971			MAY 25, 1972			AUG 22, 1972		
Fish (Pci/g ash)	Weight (g)	Sr-90 in bone	Cs-137 in flesh	Wt (g)	Sr-90 in bone	Cs-137 in flesh	Wt (g)	Sr-90 in bone	Cs-137 in flesh	Wt (g)	Sr-90 in bone	Cs-137 in flesh
Yellow Perch	–	1.3	10	–	1.6	18.3	172	1.6	19.1	310	3.4	25.3
	–	1.9	10	–	1.6	20.3	192	1.4	25.0	217	2.0	23.4
	–	1.5	12	–	2.9	11.6	275	1.1	14.9	309	1.4	16.8
	–	2.1	22				206	1.7	15.4			
	–	1.9	19				479	1.3	23.6			
Brown Bullhead	–	3.2	1							208	2.8	17.1
	–	0.6	3				247	2.8	2.1	167	2.9	18.1
	–	2.9	6				197	2.1	3.7	199	2.7	5.4
	–	2.6	4				179	2.0	4.3	240	2.5	5.4
	–	2.8	3							185	2.7	1.8
Silver Bass				–	2.0	13.8	172	2.1	16.0	320	2.9	11.7
				–	2.3	12.4	285	2.2	13.2	174	2.6	10.3
							183	1.3	11.6			
							147	2.3	10.6			
							165	2.1	17.4			
Pike				–	1.9	10.4						

TABLE 6.13

ACTIVITY UPTAKE IN CLADOPHORA

Date		Activity* Gross γ	(pCi/g, dried sample) Gross β
Aug	1967	4.0	39
Sep	1968	3.5	61
Oct	1969	1.5	35
Jan	1971	3.1	46
Apr	1972	6.2	33
May	1973	2.0	40

* Average activity from several samples

three near-shore locations averaged 72°F. The maximum hourly temperature averaged 75°F near shore and was 71°F at the 25-foot depth a mile offshore. In 1971 and 1972 the maximum daily mean and hourly temperatures at the offshore locations were 72°F and 69°F respectively. With one unit operating during the summer and fall of 1971, the maximum daily mean and hourly temperatures recorded in the cooling water outfall channel were 88°F and 90°F respectively. From July to November, 1972, the station was shut down.

Large temperature variations occurred from day to day and within the day on several occasions during 1970-1972. Consecutive daily mean temperatures varied by as much as 11F° near shore and 13F° at 25-foot depth a mile offshore. Hourly temperatures varied within the day by as much as 14 to 18F° near-shore and 24F° offshore, while hourly temperatures on consecutive days varied by as much as 20F° near-shore and 25F° offshore.

Vertical temperature profiles were obtained in 1970, 1971, and 1972, at various distances offshore up to two miles and indicated surface warming in May and June, larger temperature gradients from July to early September and return to isothermal conditions in October.

Water temperature was also recorded in Frenchman Bay during August to October 1970. Maximum daily mean and hourly temperatures were 80°F and 83°F respectively. Temperature measurements were taken again in 1971 and the maximums were 6F° lower than those recorded in 1970. Water temperatures have been recorded by Ontario Hydro at the time of biological sampling (21,107).

Other surveys of the lake thermal regime (10, 12, 4, 5, 6) have confirmed the local and lake wide variability of temperatures. Storms, seiche action and meteorological conditions combine to produce rapid local temperature fluctuations. Strong winds cause upwelling at the leeward shores by causing a displacement of the surface waters in a wind direction. This effect is most noticeable when the lake is well stratified; it may, in summer, cause temporary local reductions in surface temperature by as much as 12 to 15C° to a low of 4C° (12).

The yearly cycle is the most important perturbation determining the thermal structure of the lake. It consists of two phases, a heating phase lasting roughly from mid-March to mid-September, and a cooling phase during the remainder of the year (67, 68).

6.2.4 Thermal Discharge

The cooling and service water requirements are approximately 1000 cfs per unit and the temperature rise through the condensers at full load and full flow is approximately 20F°. The total cooling water flow from the upgrading plant is 22.3 cfs with a T of 20F°. The flow is directed into the main CCW discharge channel of Pickering G.S.-A.

Figure 7 shows a prediction of the lake surface thermal plume with Pickering G.S.-A operating.

Thermal plume surveys were started in September 1971 when the first unit was commissioned. Three surveys were completed with two units operating at full load; November 23, 1971, November 26, 1971, and June 8, 1972. These surveys indicate that with two units in operation the elevated temperatures due to discharge could be detected approximately one mile from the outfall (Figures 8-10). A survey in April 26, 1973 indicated approximately the same plume surface area when three units were operating (Figure 11).

Vertical temperature profiles in the thermal plume taken in late 1971 (two units operating) show the buoyancy of the surface discharge plume (13). Temperature profiles at one and ten foot depths enclosed 10,000 and 100 acres respectively of water greater than 5F° above intake temperature.

There have been no measurements to date to determine if the plume sinks in cold weather as shown to occur in some Lake Michigan studies (104). This phenomenon occurs when the lake temperature is less than 4°C. The heated water discharged from the power plant entrains and mixes with the cold lake water. When discharged and entrained water cools to 4°C, it is at its maximum density and sinks through the colder, more buoyant lake water. This slightly denser mass of water should flow along the lake bottom until additional mixing further reduces the temperature.

Considerable cooling water recirculation has been observed when the wind is from W or SW quadrants. With recirculation, the temperature difference between ambient lake temperature and outfall temperature is greater than the temperature rise through the condensers. In a period of observations from November 1971 to January 1972 temperature differences as high as 40F°. A boom has been installed, in the outfall area, on a test basis in order to deflect the plume and thus prevent recirculation of cooling water back to the intake before adequate cooling has taken place. The test boom consists of 500 feet of logs strung together, with a plastic curtain hanging 8 feet into the water. If data show that recirculation under west and southwest winds is reduced, consideration will be given to the installation of a boom on a permanent basis.

Tunnelling of an intake structure for Pickering G.S.-A and for the proposed station is under active consideration as one solution to the recirculation problem.

Permission was received from the Department of Transport to install two 1,000-foot rock-filled groins to be built out from the present intake channel. These groins are approximately 300 feet apart. This structure will aid in prevention of silt and weed intake into the station and would restrict thermal recirculation. Their effect will be studied with a view to decisions required for the intake structure for an 8-unit station. It is expected that construction of the 1000-foot groins will be completed by the end of 1973.

6.2.5 Ice

Limited observations of ice conditions in Lake Ontario in the vicinity of the Pickering site were carried out in the period 1969-1973. The investigations consisted of a general recon-

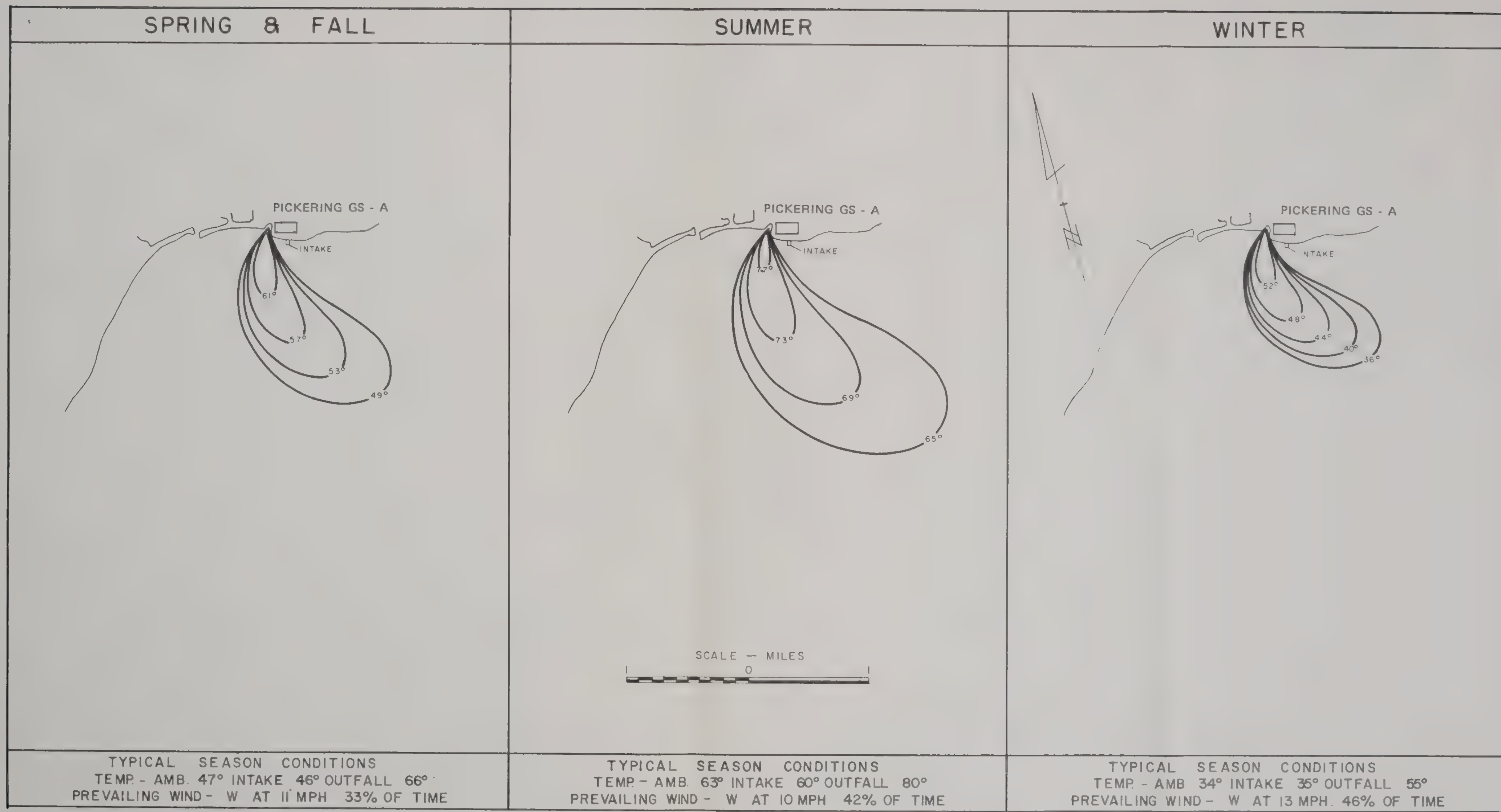


FIGURE 7 LAKE SURFACE THERMAL PLUME PREDICTION

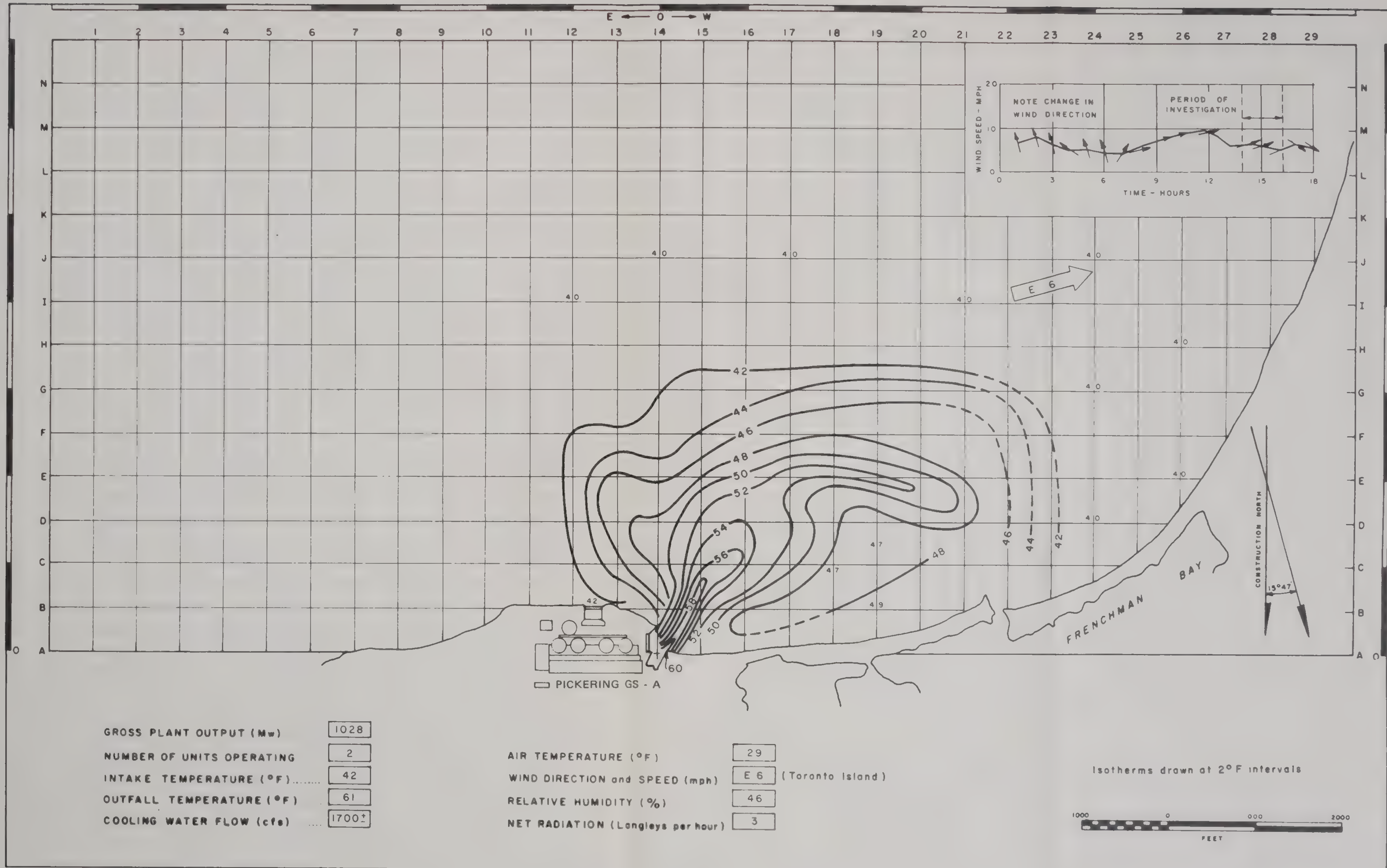


FIGURE 8 THERMAL PLUME, NOV 23, 1971

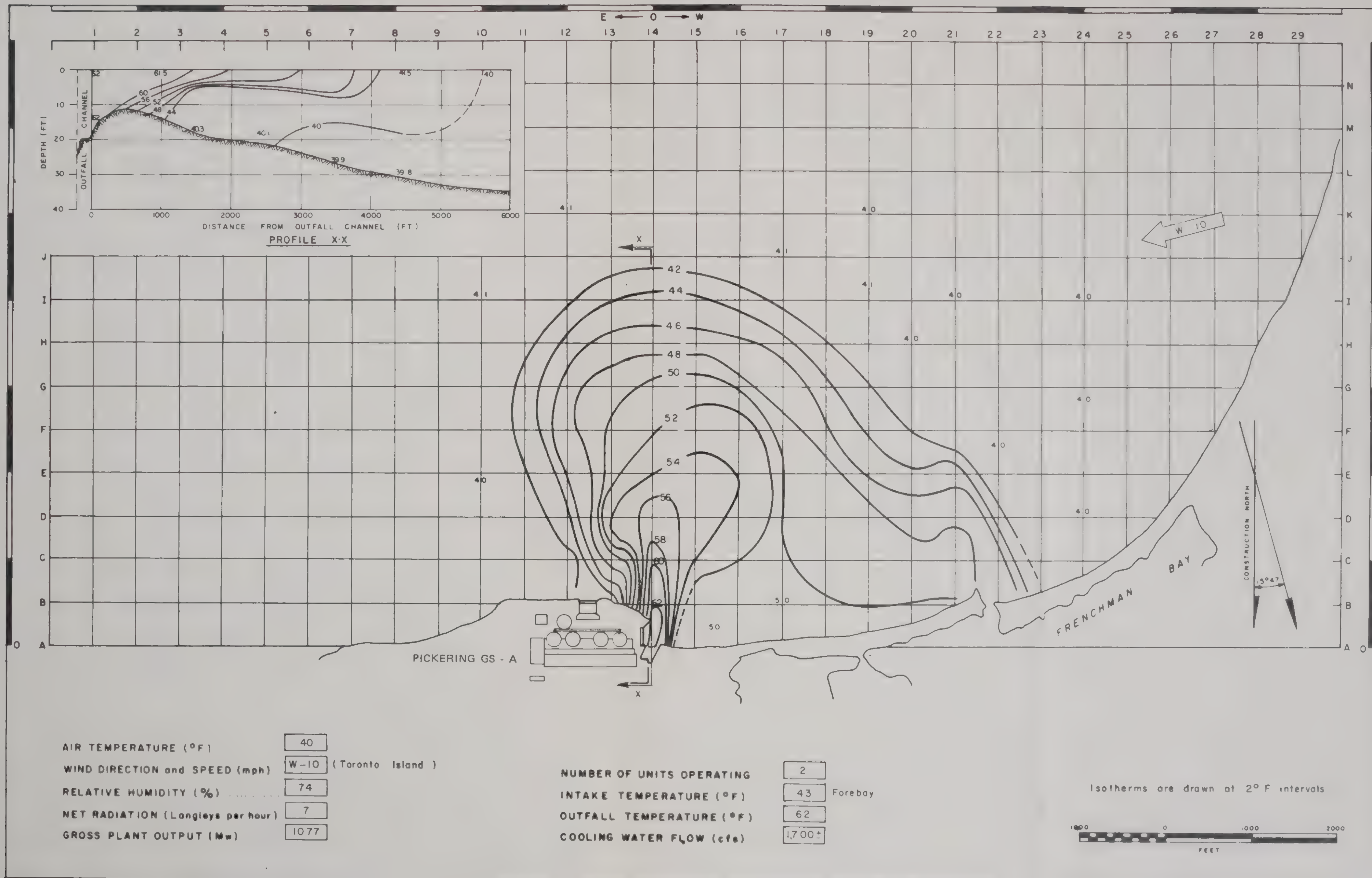
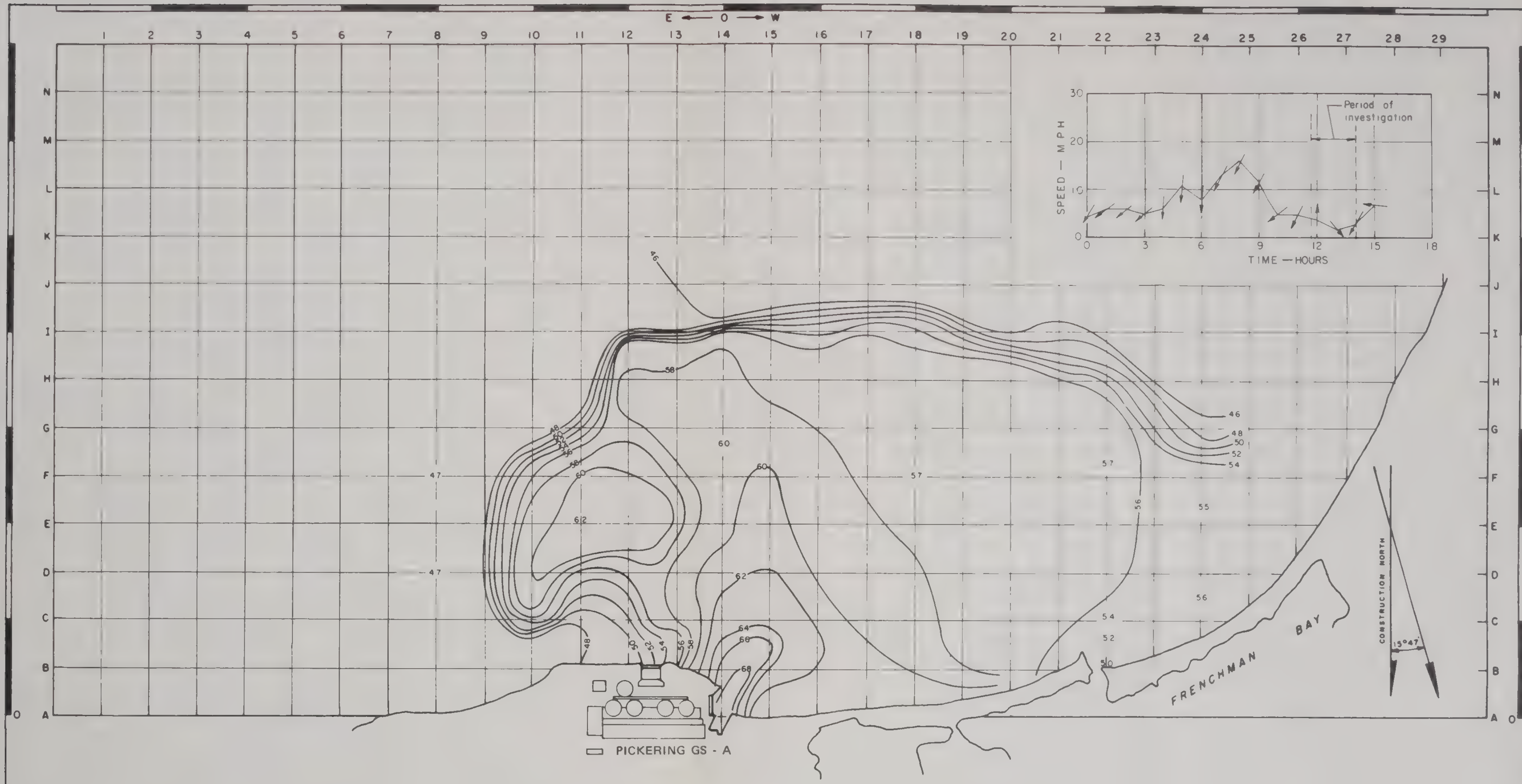


FIGURE 9 THERMAL PLUME, NOV 26, 1971



AIR TEMPERATURE (°F)	61	
WIND DIRECTION and SPEED (mph)	C	Variable 2-4
RELATIVE HUMIDITY (%)	84	
NET RADIATION (Langleys per hour)	14.0	
GROSS PLANT OUTPUT (Mw)	1081	

NUMBER OF UNITS OPERATING	2
INTAKE TEMPERATURE (°F)	49
OUTFALL TEMPERATURE (°F)	68
COOLING WATER FLOW (cfs)	1700±

Isotherms drawn at 2° intervals
Water surface elevation 247.0 C.G.D.

FIGURE 10 THERMAL PLUME, JUNE 8, 1972

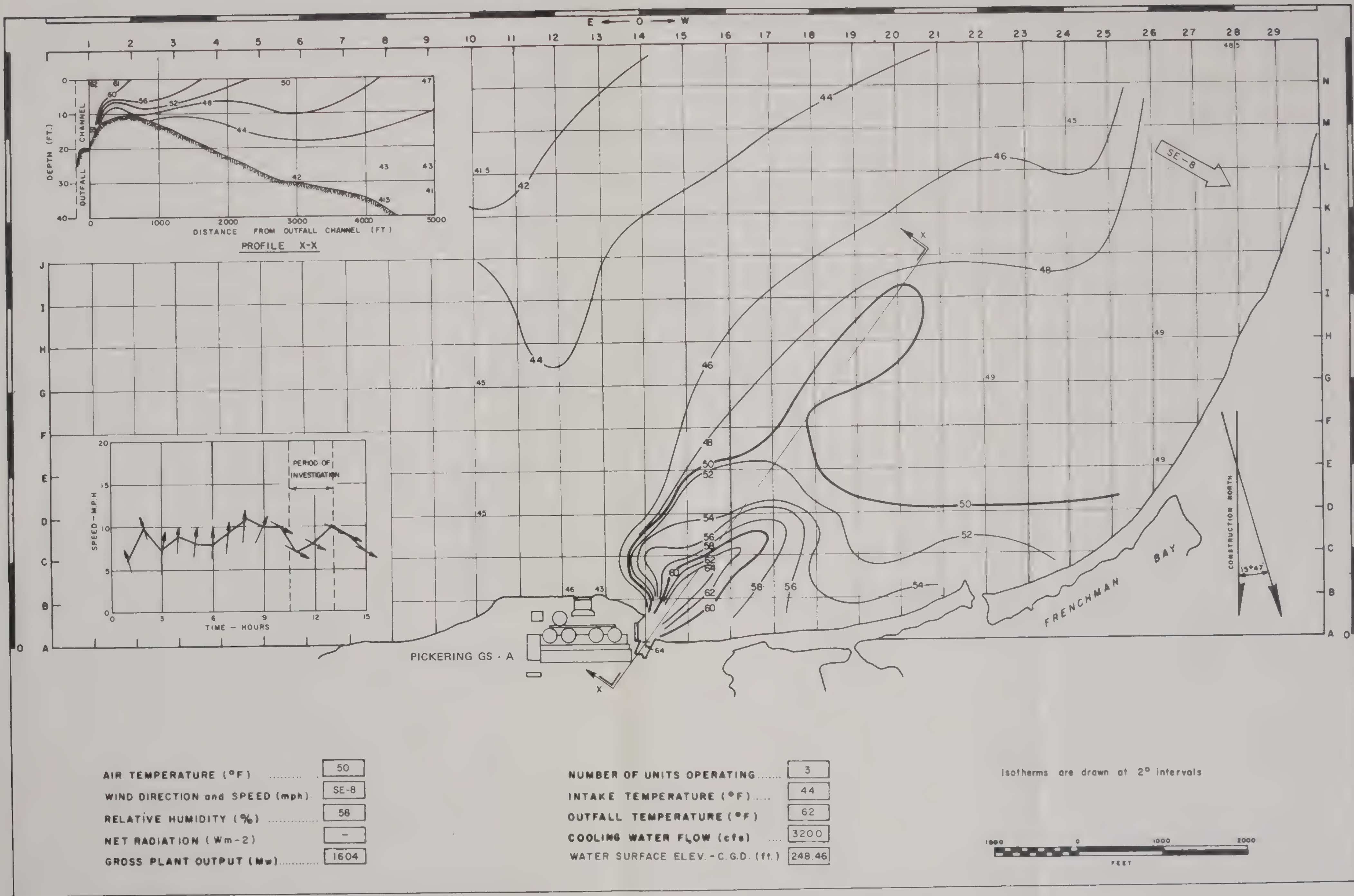


FIGURE 11 THERMAL PLUME, APRIL 26, 1973

naissance, to map the extent of ice cover from an aircraft, and ground observations to determine the ice conditions along the shore (8).

Observations have indicated no extensive ice cover in the vicinity of the Pickering site. However, a considerable amount of slush and pancake ice forming into ice floes has been observed during the months of January and February. In 1971, a winter when ice conditions were most severe, the cooling water discharge area and the bay immediately east of the station had large amounts of pancake, ball and slush ice pushed together as a solid but floating mass of ice up to 2,000 feet offshore. The amount and duration of this slush ice depended largely on the direction of winds. South and south-east winds tend to push it toward the shore. Ice ridges as high as 15 feet were observed in most winters on each side of the site. The dyke in front of the station, however, remained void of any ice ridges.

Frenchman Bay is covered by a thin sheet of ice at the onset of first freezing temperatures, and remains frozen up to the middle of March.

6.2.6 Aquatic Life

6.2.6.1 Fish

(a) Fisheries Resources

Water quality in Lake Ontario very strongly influences the character of the lake fisheries. A recent survey by the Ministry of Natural Resources (18), identifies local fishing and spawning sites. In the spring and fall, rainbow trout migrate up Duffin Creek, two miles east of the station site, to spawn. Spawning of other species such as coho salmon, are also thought to occur in the marshes and upper reaches of the Rouge River. The remainder of the spawning of local species probably occurs along the shoreline and in the main body of Lake Ontario.

Fish, such as rainbow trout and coho salmon were stocked in the lake recently. Both coho and rainbow trout are appearing in many of the streams between Oshawa and Toronto. In the spring of 1972, rainbow trout were stocked in the mid-sections of Duffin Creek (18).

At present, fish such as yellow perch, sunfish, suckers, carp, catfish, alewife and smelt are the main species found in the area.

(b) Commercial Fishing

In 1971 there was only one licensed commercial fisherman along this section of the shoreline. Catches consisted of smelt and alewife. In 20 miles of shoreline there are eight licensed commercial bait fishermen. The 1956-1970 commercial catch in pounds is given in Table 6.14 (18).

(c) Sport Fishery

New York State and Ontario are endeavouring to develop a diverse sport fishery by planting of hatchery stock. Species selected for introduction include: coho, chinook, atlantic salmon, steelhead and splake. All are fine game and food fish, having proven capability to survive in Lake Ontario and may have the capacity to transform the lake's abundant forage fish resources into a prime fishery.

Success of the program will depend upon several factors including control of the sea lamprey, large annual plantings of hatchery-reared salmon and trout, maintenance of good water quality and the maintenance of an abundant food supply for these fishes (20).

TABLE 6.14

COMMERCIAL CATCH BY SPECIES (IN POUNDS)

SPECIES YEAR	1956	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Carp	—	—	—	—	—	—	—	15119	3417	—	938	989	—	—	—
Catfish	—	—	—	—	—	—	—	4	17	—	—	11	—	—	26
Eels	—	—	150	630	532	1	465	189	230	—	—	43	—	—	—
Yellow Perch	91	—	—	—	—	—	138	170	2	94	71	90	—	—	780
Rock Bass & Crappies	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Smelt	57803	45044	49356	61569	32293	47881	73034	61640	21444	43601	14000	50628	72775	17470	5390
Round Whitefish (or menominee)	380	—	—	970	123	70	—	148	—	—	—	—	—	—	—
Suckers, incl. Quill Back Suckers	—	—	—	—	—	18	—	10	—	—	—	58	—	—	16
White Bass	162	62	—	—	—	—	—	1	—	—	—	13	—	—	—
Lake Whitefish	63	—	—	55	—	—	—	3	—	—	—	—	—	—	—
Yellow Pickerel	—	—	—	—	—	—	—	29	—	—	—	—	—	—	—
Lake Herring	1980	—	—	—	8164	—	—	—	—	—	—	—	—	—	—
Lake Trout	—	—	—	19	—	15	—	—	—	—	—	—	—	—	—
Chub	4380	1870	—	—	—	—	—	—	—	—	—	—	—	—	—
Saugers	35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Northern Pike	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
Whitefish	—	—	—	—	—	—	—	—	—	—	41	—	—	—	23

In the spawning season during late April and early May, fishermen catch smelt at the river mouths (18).

(d) Fish Studies at Site

A program of biological studies at the Pickering site was initiated in 1970 (21). Fish populations were measured by gill netting at a control location and at locations in the thermal plume at monthly intervals from May to November, 1971. Coarse and game fish populations were greater in the thermal plume than in the cold water control area during the May, June, October and November sample periods and lower during July, August and September. No physical differences were detected between fish caught in thermal discharge and control areas. Fifteen species of fish were identified during the sample nettings from May to November, 1971 (Table 6.15).

The most frequently caught species, accounting for 90% of the total catch, were yellow perch, common white suckers, silver bass and brown bullhead.

In the period July-October 1972, the station was shut down but the on-site studies were carried out during the normal season, May-November (107). The change from gill nets to trap nets in 1972 does not allow a direct comparison to be made of fish population and species. Coho salmon, whitefish and gizzard shad were not caught in 1972, but sunfish, chub, bowfin and American eel were additional species caught in very small numbers. In the first two months of shutdown, numbers of fish caught in discharge and control areas were similar. In the remaining two months, numbers in the discharge area were much higher than at the controls particularly in September when the cooling water pumps were operating.

TABLE 6.15

FISH SPECIES CAUGHT OFF THE SITE

Coho Salmon	*(Oncorhynchus kisutch)*
Northern pike	*(Esox lucius)*
Small-mouth bass	*(Micropterus dolomieu)*
Rock bass	*(Ambloplites rupestris)*
Silver bass	*(Lepibema chrysops)*
Whitefish	*(Coregonus culpeaformis)*
Yellow perch	*(Perca flavescens)*
White perch	*(Morone americana)*
Brown bullhead	*(Ictalurus nebulosus)*
Gizzard shad	*(Dorosoma cepedianum)*
Common white sucker	*(Catostomus commersonnii)*
Carp	*(Cyprinus carpio)*
Smelt	*(Osmerus mordax)*
Alewife	*(Alosa pseudoharengus)*
Sea lamprey	*(Petromyzon marinus)*

(e) Fish Entrainment

Power plants using once-through cooling entrain a portion of the aquatic biota. Any impact on the local aquatic ecosystem due to entrainment depends on the relative numbers of each species entrained, and the ability of each species to withstand the entrainment stresses and to effectively function and reproduce thereafter.

Stress on entrained organisms is caused by mechanical damage, pressure changes, thermal shock and exposure to chemicals discharged into the cooling water.

At Pickering G.S.-A the intake velocity at the skimmer wall with four-unit operation is 1.6 ft./sec. The forebay area acts as an intake well and, as such, the velocity decreases in this area to 0.8 ft./sec. The velocity at the intake screens, the point at which impingement occurs, is 2.0 ft./sec. Large fish are able to swim back against the intake velocity in the forebay area and out into the lake, but smaller fish and larvae are held in the forebay area and are eventually entrained.

Figure 12 shows the fish intake during 1972 and 1973. The average weight of fish removed from the intake screens is approximately 10 lbs per day during the off-peak runs. During the spring spawning seasons for smelt and alewives, the average intake of fish was 2000 lbs per day with peak intakes as high as 6000 lbs per day in 1972 and over 10,000 lbs per day in 1973.

6.2.6.2 Phytoplankton

The central part of the lake is characterized by low densities of algae and fairly homogeneous lateral distribution of plankton whereas the inshore areas show a more irregular but higher distribution pattern. Diatoms, cryptomonads and green algae, in that order, are the most important constituents of the lake phytoplankton, while chrysomonades and dinoflagellates do not play the role they could have been expected to, from the temperature and nutrient conditions of the lake. The annual average composition of the phytoplankton for the general area around Pickering was found to be: (11)

Cyanophyta	10%	(blue-green)
Chlorophyta	16%	(green)
Chrysomonadinae	15%	(yellow-green)
Diatomeae	33%	(diatoms)
Cryptophyceae	20%	(yellow-brown flagellates)
Dinophycinae	6%	(armoured flagellates)

In the winter and spring, diatoms are 80% of the plankton volume. The plankton in the summer maximum and the fall show more diversity, with green algae as the biggest single group, followed in importance by blue-greens and cryptomonads. A pronounced spring maximum appears in the inshore region. The summer maximum develops earlier but more irregularly in the off shore region. Stations are defined as inshore if they are less than 25 meters deep (11).

The persistence of certain diatom species of the inshore regions during all seasons of the year may be indicative of eutrophic conditions in the near shore waters of Lake Ontario (12). In the main body of the lake, however, phytoplankton concentrations indicate mesotrophic to oligotrophic conditions.

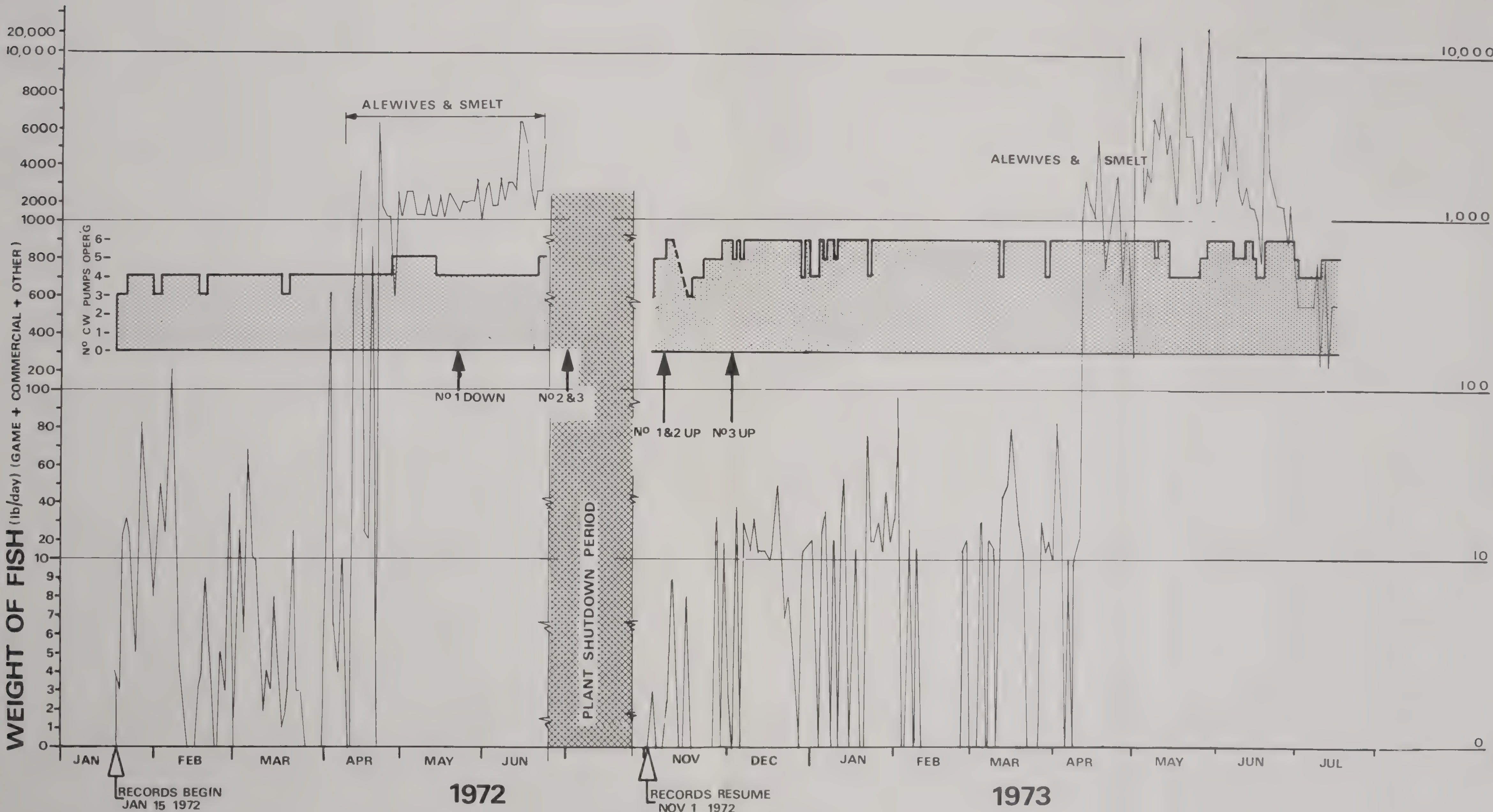


FIGURE 12 FISH REMOVED FROM INTAKE SCREENS

6.2.6.3 Bottom Fauna

An area extending from the western end of the Scarborough Bluffs to east of the Pickering site was surveyed for bottom fauna in 1966-1967 (12). The results are indicative of oligotrophic conditions. The average community consisted of:

amphipods - 39%
lumbriculids - 24%
midges - 12%
clams - 12%
tubificids - 12.8%

The Ontario Hydro studies at the Pickering site during the period 1970-71 (21) discovered no significant difference between the number of taxa found at the thermal discharge and control stations. There was some variability in the number of taxa at each station at any one sampling time but the average numbers of taxa at each station were similar. Populations at each station varied widely during the sampling period, with much higher average numbers at the stations in the thermal discharge area (Table 6.16). The location of benthic fauna sampling stations is shown in Figure 13.

TABLE 6.16

NUMBERS OF INVERTEBRATE TAXA FOUND
AT EACH SAMPLE STATION
1970 – 1971

TAXA PER STATION

	Frenchman Bay		Thermal Plume			Control Locations	
Station No.	1	2	3	4	5	6	7
Date							
Oct 1970	5	7	7	7	7	9	6
Nov 1970	7	9	11	9	9	6	4
May 1971	4	6	6	5	5	7	5
Jun 1971	4	8	7	6	6	7	7
Jul 1971	7	5	7	5	7	6	5
Aug 1971	8	4	6	5	7	6	4
Sep 1971	8	4	7	8	–	–	7
Oct 1971	9	10	6	8	7	7	8
Nov 1971	7	–	9	5	–	8	8
Total	59	53	66	58	48	56	54
Avg/Month	6.6	5.9	7.3	6.4	6.9	7.0	6.0
Avg. No. of Specimens per Sample	142.4	59.0	242.2	412.52	686.2	195.6	26.3

These levels suggest that the sampling stations within the expected thermal plume area were in an area of higher biological productivity than the control or normal lake locations.

Of the common groups found in the samples from both thermal plume and control areas, the isopod (*Asellus*) and amphipod (*Gammarus*) were most numerous. Midge larvae (*Chironronidae*) and snails of the genus (*Physa*) were also generally present.

The 1972 studies included a period of four months when the plant was not operating. Benthic populations were generally lower closer to the discharge during the shutdown and increased when the plant resumed operation in November (107).

6.2.6.4 Zooplankton

There is very little published information on the zooplankton population in the vicinity of the Pickering site. The Ministry of the Environment sampled regularly between May and September 1967. On the average, the eastern part of the lake was richer in planktonic crustacea than western and central parts (12).

6.2.6.5 Filamentous Algae and Rooted Aquatic Plants

Extensive investigations of the growth of filamentous algae in Lake Ontario in the vicinity of the Pickering site were carried out in the summer and fall of 1968 and 1969 followed by routine observations in 1970 and 1971. The investigations consisted of mapping and photographing the algae beds from the air, underwater observations with the help of skin divers and visual inspection along the shore. The program consisted of observing the progressive changes in location, extent and density of growth as well as to ascertain the location and extent of shore line accumulation (9).

It was established that the area around the Pickering site is heavily infested with the growth o the filamentous algae, Cladophora, from west of Frenchman Bay to east of the J. Sherman Scott (Pickering Township) Water Treatment Plant. Large beds were observed west of the cooling water discharge channel, south-east of the cooling water intake and along the shoreline between the dyke and the Pickering water treatment plant. In places the growth extended to about 2,000 feet offshore. Algae growth generally started in May, reached its peak in July and August and then started to decay.

Fragmentation of algae and subsequent accumulation on the shore normally started in July and continued through September and October. Large quantities of fragmented algae were transported and held in suspension east and west of the generating station. The accumulation was exceptionally heavy in this area between the station and Brock Road to the east. In August and September the putrifying algae had a blackish jelly-like appearance and an offensive odour.

Two years of extensive investigation and subsequent observations did not indicate a significant change in algal growth and shoreline accumulation.

6.2.6.6 Bacteriology

The bacteriological quality of Lake Ontario is excellent in deep water but is degraded along the shoreline and in harbour areas. The coliform-polluted areas appear to be limited to waters well within two miles from the shore. High bacterial densities show a close correlation with heavy polluted areas. Thus, it can be concluded that bacteriological quality is average in the Pickering area (12).

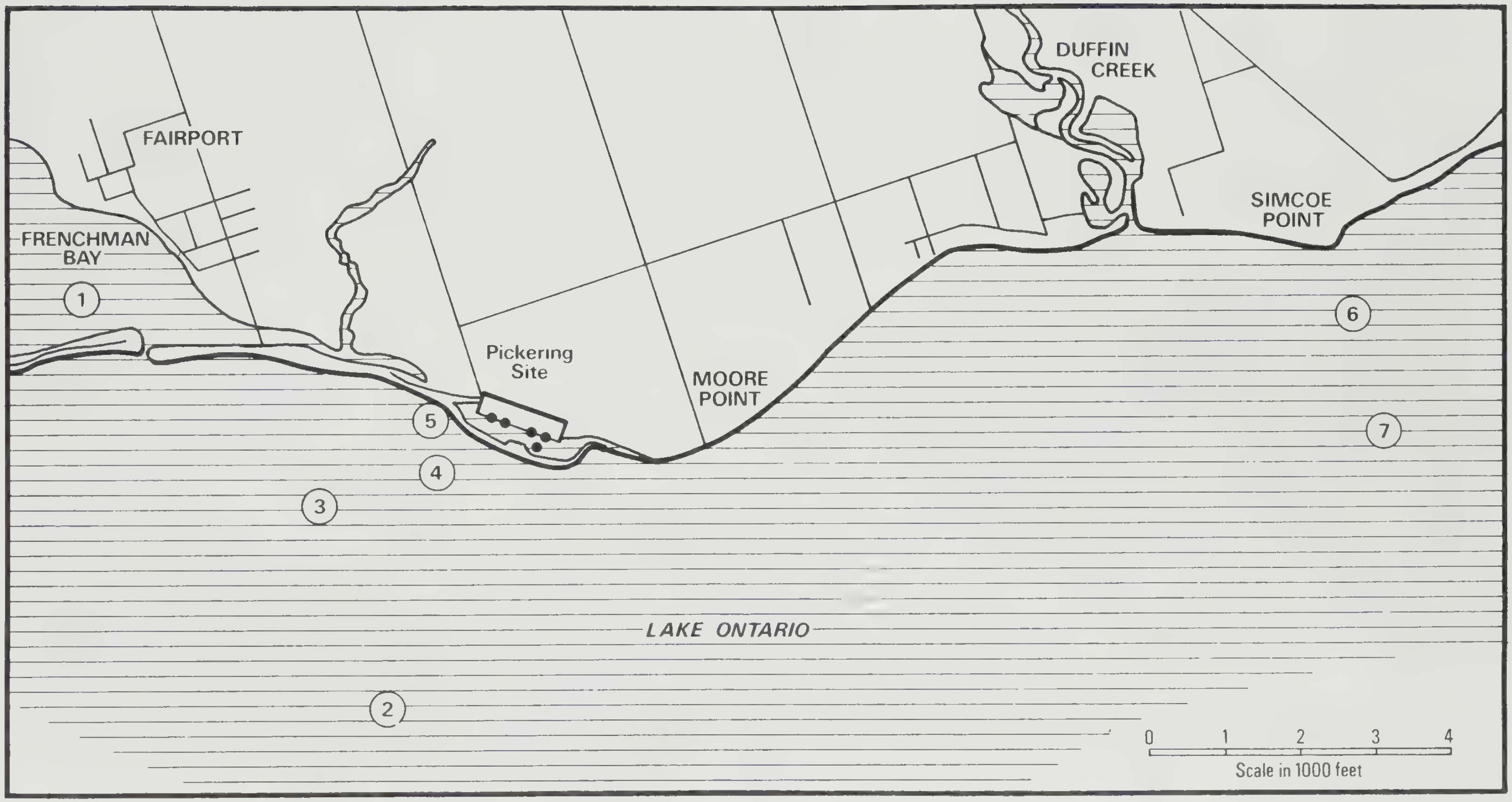


FIGURE 13 BIOLOGICAL INVESTIGATIONS – LOCATION OF BENTHIC FAUNA SAMPLING STATIONS

6.2.7 Ground Water

Ground water in the site area is generally located high within the soil overburden, about five to seven feet below the ground surface. In the area of the proposed excavation for the powerhouse yard, the ground water was found during investigation to be at about El. 260. Excavation in the Pickering G.S.-A area changed somewhat the flow pattern of the ground water within the site, especially near the cut slopes. Instead of flowing southwards towards the lake, part of the ground water within the site area now flows into the artificial drainage system.

6.3 SITE AREA

6.3.1 Topography

The proposed station location east of the existing station is situated on a slightly sloping till plain. The original shoreline consists of a 15-20 feet wide sand beach behind which rises a till bluff about 25-30 feet high. Inland, the ground rises gradually to about El. 285 at the proposed switchyard area. However, part of the area was graded during construction of Pickering G.S.-A. There is no local drainage system in this half of the site.

6.3.2 Geology

With the exception of the beach strip the site area is covered with a thin layer of top soil followed by a layer of glacio-lacustrine silts and fine sands less than five feet thick. Glacio-lacustrine soil is a layer of wet and soft glacial till complex about 35 feet thick. Below the soft till and overlying bedrock is a thin layer of dense interglacial sands sandwiched between two thin layers of very dense glacial till. Along the present shoreline, part of the soft glacial till has been eroded leaving a thin surface layer of beach sand and gravel.

Close to shore, the lake bottom is almost flat, dropping only 20 feet or less at a distance of 2000 feet from the shoreline. The subsoil along the shore is identical to that along the narrow beach strip described above. Further into the lake, the thin layer beach sand and gravel pinches out. Bedrock is a flat-lying thinly bedded shale of the Dundas formation. Its surface slopes gently towards the south and east. In the proposed powerhouse area the bedrock surface is at about El. 197 on the west side dropping down to about El. 183 in the east.

6.3.3 Seismology

Based on the Seismic Zoning Map published by the Federal Department of Energy, Mines and Resources in 1969, and adopted in the 1970 National Building Code of Canada the Pickering site is located in Seismic Zone 1 with only minor earthquake damage probabilities. The magnitude of the seismic shock designated for this zone in the National Building Code of Canada is equivalent to a horizontal ground acceleration of 2.5% gravity, corresponding to a return period of 100 years. For the design of the nuclear containment structures and some other equipment a value of 5% gravity will be used.

6.3.4 Vegetation

The original tree cover in the site area has been long since removed and the land converted to agricultural use. Only a few trees, mainly sugar maple, elm and beech, are left to mark the lot boundaries and ownership. The area is now considered good crop land with good to moderately good drainage. The soil is fertile and produces high yields of corn, grain and hay. Vegetation cover found along the shore and in the areas of Ajax Marsh or Pickering Beach was detailed in a report by the Ministry of Natural Resources (69).

Planted trees and remnant hardwoods and conifers interspersed with vacant grass lots are found in the residential area. Typical trees of this marsh area are white spruce (*Picea glauca*), black willow (*Salix nigra*), weeping willow (*Salix babylonica*), cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), tulip tree (*Liriodendron tulipifera*), and sugar maple (*Acer saccharum*).

Typical of the main marsh is the common cattail (*Typha latifolia*), with sedges (*Cyperaceae*), grasses (*Graminae*), and rushes (*Juncus*), forming a semicircle around the main marsh on the east side. The larger pools at times are covered with duckweed (*Lemna*) and pond lilies (*Nymphaea*).

Hardwoods, in two stands of ash or ash/elm, are isolated in a small patch near the marsh, and the other along Carruther's Creek, the only stream watering the whole area. Many hardwoods, especially maple, elm, poplar and willow are widely found in the two larger woodland tracts.

Typical softwoods are eastern hemlock (*Tsuga canadensis*), white cedar (*Thuja occidentalis*), black willow (*Salix nigra*), glaucous willow (*Salix discolor*), quaking aspen (*Populus tremuloides*), beech (*Fagus grandifolia*), white oak (*Quercus alba*), American elm (*Ulmus americana*), Hawthorn (*Crataequs spp.*), choke cherry (*Prunus virginiana*), pin cherry (*Prunus pennsylvanica*), sugar maple (*Acer saccharum*), black maple (*Acer nigrum*), white oak (*Fraxinus americana*), red-osier dogwood (*Cornus statonifera*), common elder (*Sambucus canadensis*), and alder (*Alnus sp.*).

6.3.5 Wildlife

Ducks are the most important wildlife resource along this section of the Lake Ontario shore and inhabit the the various marshes in the area such as Second Marsh - Oshawa, Darlington Park, and other marshy areas such as Frenchman Bay, Cranberry Marsh and the mouth of such rivers as Duffin Creek and the Rouge River (69).

Frenchman Bay area supports a variety of migratory waterfowl (21). During the spring and fall considerable numbers of mallard (*Anas platyrhynochos*). black ducks (*Anas rubipres*) and Canada geese (*Branta canadensis*) were noted on the lake. A few individuals of these species also frequented the bay. In the late fall, migrating whistling swans (*Cygnus columbianus*) have been seen along the shoreline. During the winter, the open lake forms the resting ground for large numbers of old squaw ducks (*Clangula hyemalis*).

During the summer, there is a small resident breeding population of black and mallard ducks in Frenchman Bay.

6.3.6 Recreation and Historical Significance

The portion of Ontario Hydro property directly allocated to construction of the second station has no direct public recreation or historical significance at the present time. Under development, however, are three adjacent areas within Ontario Hydro property, 31 acres as a natural wildlife sanctuary, a 50 acre day-use park and a 15 acre athletic field, all three of which should be available for public use by the end of 1973 (Figure 14).

Two miles north of the present station and on Ontario Hydro property, there is a site on which archeologists have located and unearthed refuse from an Indian village. Work on this site will not be affected by the proposed station extension.

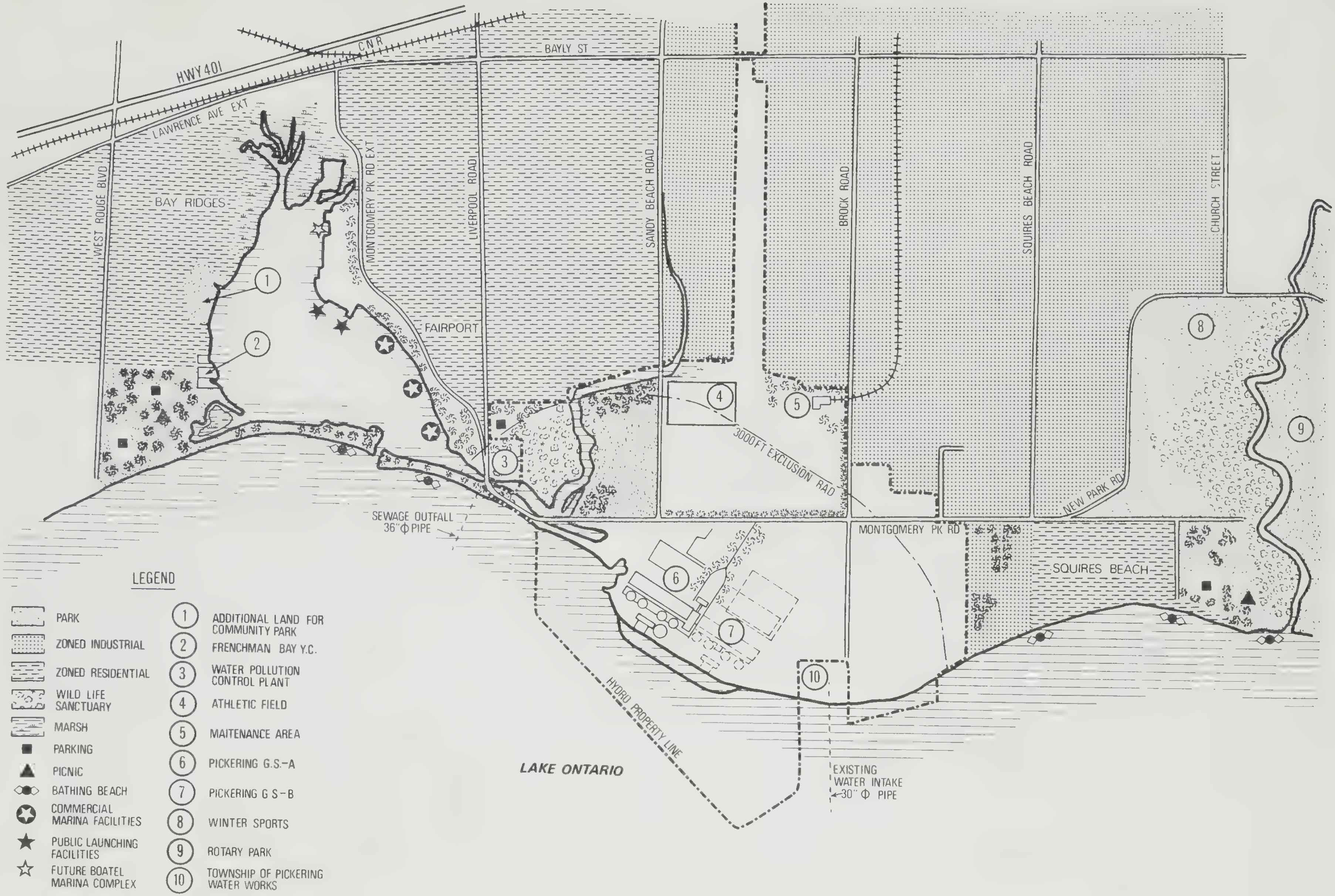


FIGURE 14 PROPOSED LAND DEVELOPMENT WITHIN 2 MILES

6.4 COMMUNITY AND LAND USE

6.4.1 Regional Development

The Pickering site is located within the newly formed Central Ontario Planning Region. This new Region is an enlargement of the former Toronto-Centred Region, and all the policies formulated for the earlier Region are presently still valid. Location of the boundaries of the new Region, as shown in Figure 15, was as of May 15, 1973 still before the Ontario Cabinet for official approval.

The three fundamental objectives of the former Toronto-Centred Economic Region were:

(1) The encouragement of a more even distribution of people in Ontario.

(2) The improvement of the quality of life for those people.

(3) Better use of the natural environment.

The Region is also designed to meet the needs of 8 million people by the year 2000.

The Toronto-Centred Region incorporated the former Central Ontario Region as well as portions of the former Lake Ontario, Georgian Bay, Niagara and Midwestern Economic Regions. The Toronto-Centred Region was divided into three zones:

(i) The Lake Ontario Urbanized Area (Zone 1) - encompassing the Metropolitan core itself, plus reasonably adjacent urban settlement from Hamilton to Bowmanville.

(ii) The Commutershed (Zone 2) - that zone beyond the lakeshore urbanized area but within easy daily commuting range of employment in Toronto.

(iii) The Peripheral Zone (Zone 3) - that belt beyond the commutershed which is still within the range of highly specialized influences of the Metropolitan core. Its economy is tied to the Region's core, and it acts as open space and recreation territory for the urban population.

The Lake Ontario Urbanized Area (Zone 1) was designated a linear urbanized area (Hamilton, Burlington, Oakville, Toronto, Oshawa, Bowmanville) with distinct urban centres separated by a Parkway Belt system of mainly non-urban uses (transportation, pipelines, electrical power lines, water and sewer lines). Oshawa and Hamilton were expected to develop into regional centre roles as well as terminal cities for mass transit.

The Commutershed (Zone 2) was specified to be retained to the maximum degree as a recreational and agricultural area and other open space uses. The high cost of providing sewer and water services throughout this zone was an important consideration in the decisions to reserve it largely for non-urban uses. Growth which does occur was to be encouraged in the municipalities northward along Highway #11, i.e., Aurora, Newmarket, Bradford.

The Peripheral Zone (Zone 3) was designated to encourage growth in the northern areas, i.e., Midland, Barrie, as well as in the east.

The Pickering site is located in Zone 1, about 20 miles east of Toronto.

For the purpose of this study, the zone of main concern is limited to a maximum of 10 miles from the Pickering plant, taking in the Borough of Scarborough, portions of Markham, Pickering and Whitby Townships, a portion of the city of Oshawa, the towns of Whitby and Ajax and the village of Pickering.

6.4.2 Population

Figure 16 shows the approximate 1970 population densities within radii of 4, 8, 12, 16 and 20 miles. Figure 17 shows the future population growth centres identified in Toronto-Centred Region planning studies, with preliminary population predictions for the years 1986 and 2001.

Approximately 30% of Ontario's total population live within the 240 square mile area comprising Metropolitan Toronto. Approximately 25% of the Metro Toronto population lives in flats and apartments. The greatest population densities are found in and around the many high-rise apartment complexes, with their usual complement of townhouses. St. James Town is presently the densest apartment complex at 345 people per acre, although it is approximately 18 miles from the plant site.

The Borough of Scarborough has the highest average ratio of residents per acre (Table 6.17), even though approximately 12% of the area is still used for agricultural purposes and a similar amount of land is set aside for industrial use. This is to be expected due to the rapidly increasing number of high-density residential complexes in the Borough. Predicted population centres in 1986 are given in Table 6.18.

TABLE 6.17

EXISTING POPULATION CENTRES

Name of Municipality	1971 Population in 1000's	Approx. Area (Sq. Miles)	Average Density (People/Acre)
Ajax	12	5	3.9
Pickering	2	2	3.7
Pickering Twp.	31	123	0.4
Whitby	24	12	4.6
Oshawa	90	22	6.3
Scarborough	325	70	7.3

TABLE 6.18

FUTURE POPULATION CENTRES

Name of Centre	Estimated 1986 Population in 1000's	Approx. Area (Sq. Miles)	Average Density (People/Acre)
Cedarwood	50	22	3.9
Dunbarton-Ajax	80	31	4.0
Whitby-Oshawa	180	52	5.4
Scarborough	540	70	12.0

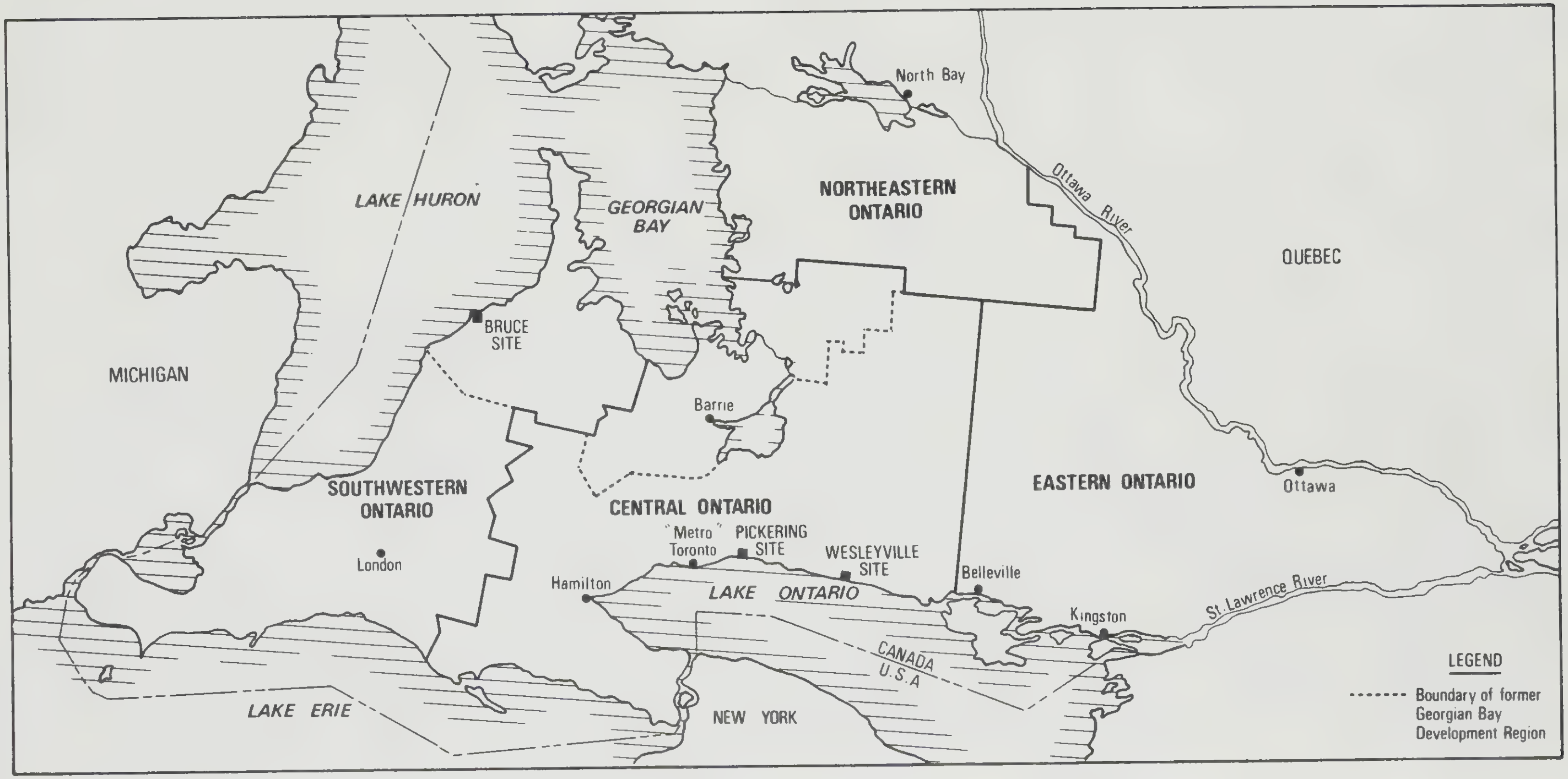
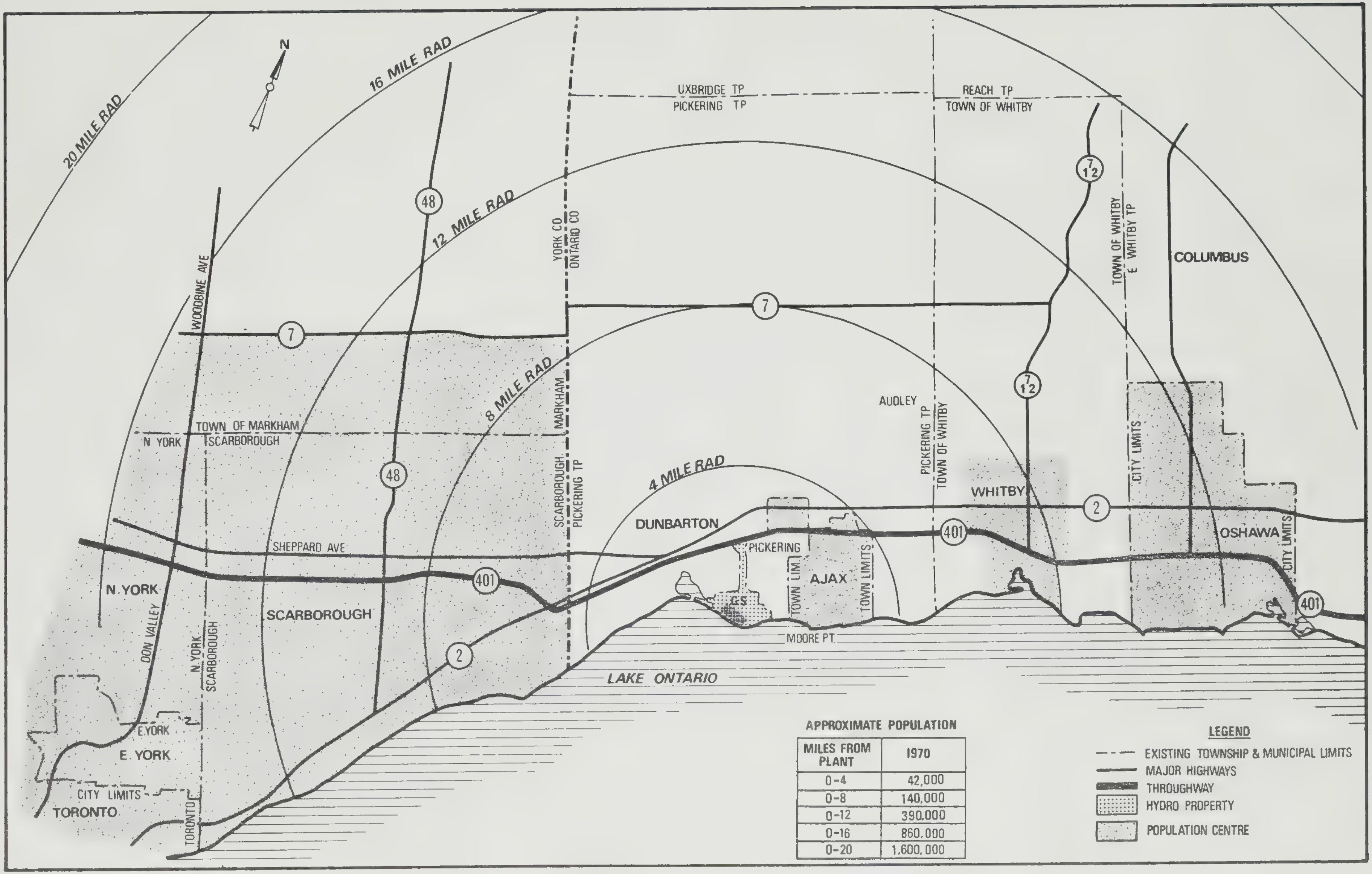


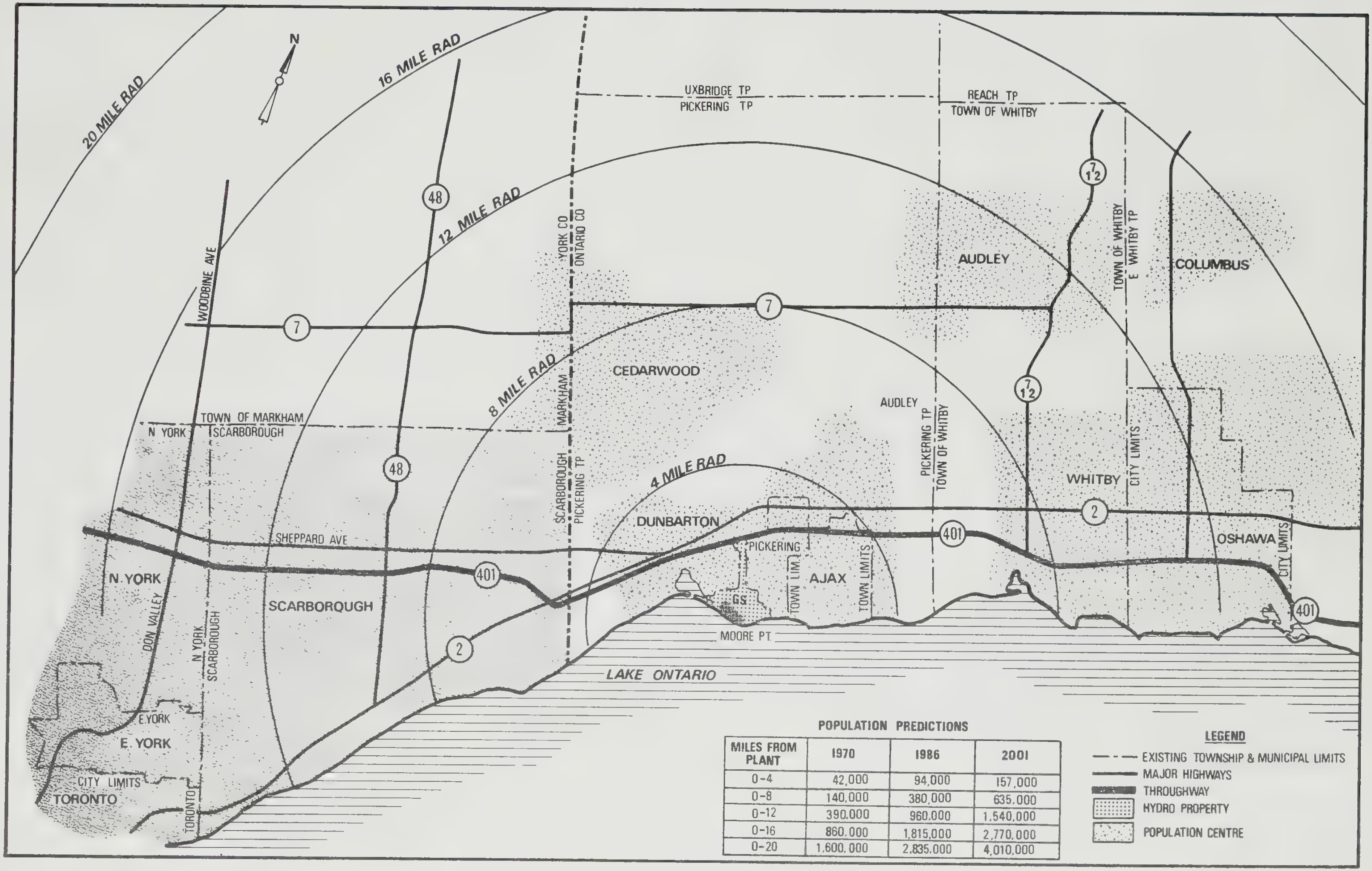
FIGURE 15 PROVINCE OF ONTARIO: PLANNING REGIONS



APPROXIMATE POPULATION

MILES FROM PLANT	1970
0-4	42,000
0-8	140,000
0-12	390,000
0-16	860,000
0-20	1,600,000

FIGURE 16 CURRENT POPULATION MAP



POPULATION PREDICTIONS

MILES FROM PLANT	1970	1986	2001
0-4	42,000	94,000	157,000
0-8	140,000	380,000	635,000
0-12	390,000	960,000	1,540,000
0-16	860,000	1,815,000	2,770,000
0-20	1,600,000	2,835,000	4,010,000

FIGURE 17 PREDICTED POPULATION DISTRIBUTION

6.4.3 Industry

There are several small commercial or industrial concerns located along the station access road (Brock Rd.). Little industrial activity has taken place within the Village of Pickering with the exception of a small firm manufacturing concrete blocks. Within Pickering Township there are about 22 light manufacturing industries, e.g., cable insulation, metal components and electrical equipment companies. Approximately 75% of these enterprises commenced production since 1960. Industrial build-up in Ajax started in the 1940's and there has been a consistent expansion since. In the five to ten mile zone there is a considerable number of industrial areas in the Borough of Scarborough and in Whitby/Oshawa.

A preliminary survey shows no mining or resource industries within the zone of concern. One private gas producing well is located in Markham Township about 14 miles north-west of the site. There are no commercial gas producers within 25 miles of the plant although records show 14 other borings which encountered signs of natural gas deposits.

More industrial build-up is anticipated along the plant access road. The area to the west of the road will probably remain dominated by light industry, while heavier industry may begin to appear on the east side once the railway siding for the new Ontario Hydro maintenance centre is constructed (Figure 4).

6.4.4 Agriculture

Most of the land within five miles of the site is either developed or being retained for future urban or industrial expansion south of the MacDonald-Cartier Freeway. To the east of the access road there is limited farming. Along Squires Beach Road there are commercial orchards and mixed vegetable farms as well as privately operated mixed crop farms (corn, alfalfa). North of the MacDonald-Cartier Freeway and within the five mile radius, there is one commercial nursery, several orchards and mixed crop farming. To the north of Pickering Village is a commercial nursery and a sod farm.

In total, the agricultural output within ten miles of the site is small, representing only a minute fraction of the total Provincial production. Table 6.19 lists the actual production in the zone of concern (98).

6.4.5 Labour Market

The zone within ten miles of the site is in the largest collective industrial complex and mixed labour resource in Canada.

Project statistics show that only 21% of total construction forces and only 11% of operations forces involved in Pickering G.S.-A in the peak labour year of 1970 moved into the area. Almost 30% of construction forces and over 50% of operations forces resided in the smaller communities outside Metro Toronto in the vicinity of the station. It can therefore be concluded that this area can supply a large portion of the skilled labour required for construction of large projects.

6.4.6 Education

The zone within ten miles of the site is representative of the most advanced educational facility within the province. There was no problem in fulfilling the educational requirements of the labour force at the present station. Any specialized training is provided by Ontario Hydro.

TABLE 6.19

1971 CENSUS OF AGRICULTURE (98)

	Units	5 Mile Radius	Between 5 & 10 Mile Radii	10 Mile Radius
No. of Census-farms	Number (No)	112	336	448
Area of Census-farms	Acres (Ac)	10,338	35,291	45,629
Spring Wheat	Ac.	40	71	111
Winter Wheat	Ac.	674	1,462	2,136
Oats	Ac.	250	2,679	2,929
Barley	Ac.	714	2,231	2,945
Mixed Grain	Ac.	790	2,124	2,914
Rye – Fall	Ac.	–	6	6
Buckwheat	Ac.	–	53	53
Peas	Ac.	–	–	–
Beans	Ac.	–	63	63
Corn for Grain	Ac.	1,573	3,909	5,482
Alfalfa	Ac.	775	4,054	4,829
Hay	Ac.	762	2,119	2,881
Oats for Fodder	Ac.	1	34	35
Corn for Ensilage	Ac.	362	1,672	2,034
Other Fodder Crops	Ac.	50	4	54
Soybeans	Ac.	–	50	50
Potatoes	Ac.	28	12	40
Other Field Crops	Ac.	120	343	463
Cattle	No.	1,340	6,619	7,959
Pigs	No.	3,796	5,002	8,798
Sheep	No.	128	585	713
Horses	No.	158	550	708
Goats	No.	32	36	68

6.4.7 Medical

The zone within ten miles of the site lies partially within Metro Toronto where adequate medical attention can be provided.

6.4.8 Transportation

The Pickering site is served by a considerable transportation network, ranging from provincial, township and municipal roads, to railways and public transportation. There is ready access to provincial highway No. 2 and the MacDonald-Cartier Freeway as well as the Go-Transit rail service to downtown Toronto.

From the Liverpool Road exchange on the MacDonald-Cartier Freeway, the distance by road to the site boundary is 1 3/4 miles. Access to the site is also available by township roads connecting with the Pickering and Whitby interchanges on the MacDonald-Cartier Freeway and with Highway No. 2.

The main site access is via Bayly and Brock Roads. Brock Road is paved, two-laned but lacking shoulders sufficient for disabled vehicles. Several light industries have located to take advantage of the road network but these in conjunction with the project cause local traffic congestion at peak hours. During the construction phase of Pickering G.S.-A access from the Montgomery Park Road-Squires Beach Road route from the project to Bay Ridges was sharply curtailed to protect the community from construction traffic. This action has contributed to traffic congestion on the main access route.

The Provincial Government plans for the Pickering-Ajax sector of the Toronto-Centred Region call for a new MacDonald-Cartier Freeway interchange at Brock Street, eliminating the present Liverpool interchange. Lawrence would be extended (six lanes) to connect with a widened Bayly Street extending parallel to the MacDonald-Cartier Freeway as far as Oshawa. Lawrence would also be joined to Montgomery Park Road via a new road down the east shore of Frenchman Bay, serving both the east shore recreation needs as well as the Pickering station.

6.4.9 Recreation and Parkland

6.4.9.1 Existing Facilities

In addition to Darlington Provincial Park there are five conservation areas located within a 15-mile radius of the site. These are: 1. Lower Rouge, 2. Greenwood, 3. Heber Down, 4. Claremont, 5. Harmony Valley. Two of these are within ten miles of the site, in addition to a few smaller municipal or privately-developed parks (Figure 18).

Within five miles of the site there are extensive recreational facilities, including the marinas and public parks on Frenchman Bay and smaller parks and picnic areas in Pickering Village and near the mouth of the Rouge River and Duffin Creek. There are relatively high densities of cottages at Squires Beach and Fairport Beach. Frenchman Bay is the only natural harbour along the Metro waterfront east of Ashbridges Bay. At the present time, about 800 boats are based in Frenchman Bay.

Darlington Provincial Park is located on the shore of Lake Ontario some 15 miles east of the Pickering site. This 380-acre park provides day-use facilities as well as areas for campsites, trailer and group camping.

The Lower Rouge Conservation Area is located at the mouth of the Rouge River, some three miles west from the site. This area, operated by the Metropolitan Toronto Region Conservation Authority (M.T.R.C.A.), involves a 160-acre tract, with parking facilities for 200 cars. Claremont Conservation Area, also M.T.R.C.A. controlled, and 398 acres in size, is located 11 miles to the north of the site. It has parking facilities for 260 cars and has two group campsites. Greenwood Conservation Area (M.T.R.C.A.) is 682 acres in size and is seven miles to the north of the site. It can allow 300 cars, and has three group campsites.

The Heber Down Conservation area is located on Highway 7 one mile from Brooklyn, some 11 miles from the site. This 368-acre development is controlled by the Central Lake Ontario Conservation Authority (C.L.O.C.A.). Harmony Valley Conservation Area, operated also by the C.L.O.C.A., involves a 70-acre tract of land for day-use. This recreational resource is located about 13 miles east from the site.

The privately developed Graham park on the Rouge River, about four miles from the site consists of a 60-acre development with 100 trailer/tent sites. The Grand Valley Park is located on Duffin Creek about two miles north of Highway No. 2. The nearby Paulynne Park consists of a 50-acre development. Moodies Trailer Park on Highway No. 2 (Duffin Creek) is another privately-owned recreational centre close to the Pickering site. On Lynde Creek, in central Whitby, there are two additional privately-operated recreational areas (Pine Ridge and Fantasyland Parks). Many large Metropolitan Toronto Parks, such as Adams, the Willows, Highland Creek and Cedarbrook Parks are situated within the ten-mile project zone.

Presently, there are two zoos in the area, each just over 15 miles from the site. One is located in Bowmanville, a 45-acre private development, including parkland and providing 33 trailer/camping sites. The other, Riverdale Zoo, is a 9-acre site, not including adjacent parkland, and is located at the eastern limit of the City of Toronto. A new Metro zoo, of considerable size, is presently under construction in the north-east section of the Borough of Scarborough, within six miles of the site. It is located between Sheppard Avenue and Finch Avenue and is crossed by Kirkham's Road. The site will cover a total of 950 acres, including parkland.

The proposed "green corridor", linking the lakeshore areas on either side of the site, is considered compatible with the area's conceptual plan to create a continuous publicly accessible green strip along the shore of Lake Ontario on both sides of Frenchman Bay.

6.4.9.2 Future Development of Facilities

There are extensive plans for recreational resources along the lakeshore particularly within 15 miles of the site and covering the period 1972 - 1986.

In the East Point Park Section, six miles west of the site (110 acres of vacant land east of Manse Road and between the lakeshore and the CNR), plans call for phase I by 1976. During this period, the area would not be available for recreational uses due to construction of the Easterly Water Filtration Plant and expansion of the Highland Creek Sewage Treatment plant. During this phase, however, considerable onshore parksite grading would be taking place. During the second stage (1977-1982), the park would be completed, including high and low trails along Scarborough Bluffs, day-use facilities for 16,000 persons per day, together with a boat basin near the sewage treatment plant and a scenic waterfront drive. The estimated total park development cost is ten million dollars.

The proposed Petticoat Park, some 2-1/2 miles to the west of the site, would involve a 183-acre tract near to large residential areas. Of this land area, 2.6 acres are in marsh, 25.1 acres in forest and 155.6 acres in open grown-over farmland.

The proposed ultimate development of the Frenchman Bay area envisages:

(i) The bayshore including the sand spits for use by water-oriented recreational facilities, with the west shore for use by local residents.

(ii) Commercial marinas and public boat launching facilities confined to the eastern shore of the bay.

(iii) Retention of the marsh area at the head of the bay.

Incorporated in the long-range planning of the east bayshore is use of Ontario Hydro land fronting onto Liverpool Road as a parking area serving the east spit, the Ontario Hydro park as well as the local marinas. Also included is the reclamation of some 15 acres of marshy

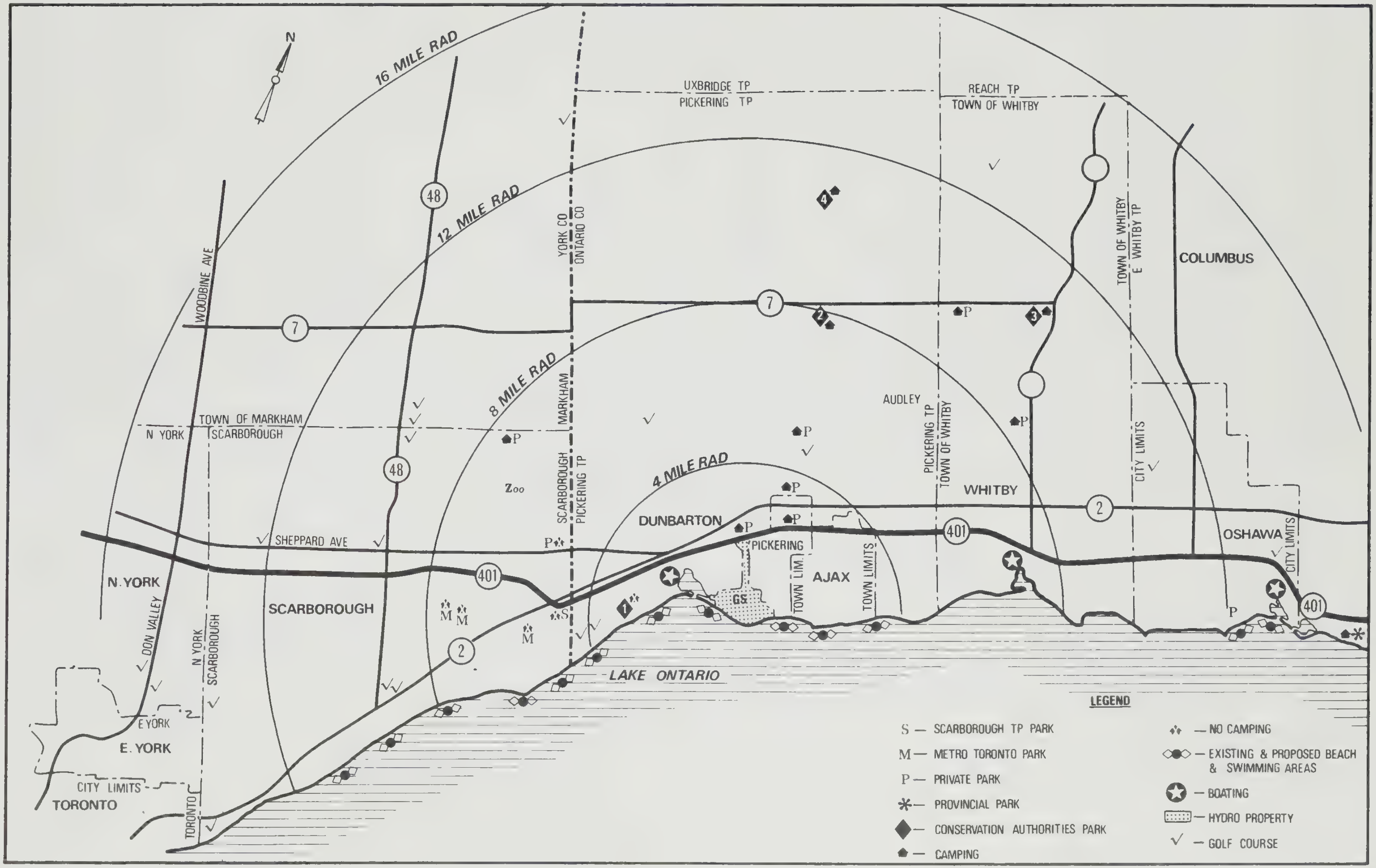


FIGURE 18 RECREATIONAL AREAS

area between Browning Street and the North East Creek for ultimate expansion of marina facilities.

Along the western side of Duffin Creek, land is being acquired by the Duffin Creek Conservation Authority for retention as a wildlife area (Fig 14). The proposed Duffin Creek Park is potentially one of the most valuable open spaces in the eastern sector of the waterfront, rich in wildlife with one of the most productive wetlands in the region. The park proposal is primarily development of a passive use, naturalistic area, with picnicing on the west side and in conjunction with a swimming area in Rotary Park on the Ajax side. The Duffin Creek area could be divided into three zones:

Zone	I	Open grass lands
	II	Treed ravine slopes
	III	Marsh land

The Duffin Creek Park proposal envisages development of 550 acres at an estimated cost of $900,000, with the main entrance off Montgomery Park Road.

6.4.10 Local Municipal Development

6.4.10.1 Residential

The area of general interest includes the easterly portion of Metropolitan Toronto, Oshawa/Whitby and the smaller communities of Markham, Ajax, Pickering, etc. The closest built-up areas are Bay Ridges, Pickering, Ajax and Squires Beach.

Bay Ridges is the closest community to the site. It is strictly a residential community, consisting of fairly new detached and semi-detached homes.

Squires Beach is a small existing community, approximately one mile east of the site, comprising some 70 dwellings. The area is unserviced and is isolated from community facilities and other residential areas in Ajax or Pickering. Existing homes are a mixture of older summer cottages, now converted into permanent homes, and a few newer permanent dwellings. The area is zoned R4, with further construction withheld pending full implementation of the Metro Waterfront Plan report.

Except for the various built-up areas, most land within five miles of the site is being held for future residential or industrial expansion.

Examination of the master plans and zoning by-laws for the communities within the area of concern show that the affected area of Scarborough, Oshawa, Ajax and Whitby permit development of high-rise apartment buildings.

Whitby has not yet undertaken any large-scale high-density development. It is still basically an area of older homes, with a business section that has undergone little or no recent redevelopment.

Ajax has undertaken an intense development program. New residential development, some high-density and some low-density, is evident throughout the community. A high-rise apartment complex is now nearing completion just south of the MacDonald-Cartier Freeway, onsisting of four 16-storey buildings for approximately 900 people.

Oshawa has until recently avoided high-density residential development. There is one large complex of fairly new high-rise apartment buildings in the northern section of the town, approximately 12 miles from the site, and one growing complex of high-rise apartment

buildings to the south and within ten miles of the site. Other than these, there are few scattered high-density residential areas. High-density development is expected to increase.

6.4.10.2 Services

Major domestic and industrial water supplies are drawn from Lake Ontario and there are a number of intakes for both purposes between Toronto and Bowmanville. The intake closest to the Pickering station (about 1/2 mile east from Reactor Bldg No. 1) is the J.S. Scott pumping station operated by Pickering Township (Figure 14). A second such installation is located at Ajax. Four water pollution control plants in the zone (Highland Creek, Bay Road, Ajax and Pickering Village), provide conventional activated sludge treatment and discharge their effluents either directly into Lake Ontario or into its tributary steams. Details of all these municipal services are given in Table 6.20.

6.4.10.3 Development Plans

Acceptance and implementation of plans in the Pickering-Ajax sector by the Provincial Government and the Metropolitan Toronto and Region Conservation Authority, as outlined in Sections 6.4.8 and 6.4.9.2, would profoundly affect future development in the site area.

The primary intention is to minimize future urban expansion within the five-mile radius zone, with the emphasis on providing recreational opportunities for the residents of the Metropolitan Toronto and Oshawa areas.

6.5 NOISE

During the operation of Pickering G.S.-A general noise levels do not normally exceed background levels at the site boundary. The only exception is during the occasional operation of steam relief valves during certain shutdown sequences. Mufflers have now been installed and it is expected that noise levels will not be greater than 50 dBA during these occasional periods at the site boundary.

6.6 TRANSMISSION LINE EGRESS

The existing transmission line corridor (500 feet wide), containing two 230kV lines, extends from the northern limits of the Pickering site and joins the main east-west power corridor at Cherrywood Transformer Station.

6.7 STUDIES IN PROGRESS

6.7.1 Radioactive Emissions

Ontario Hydro has a comprehensive radiation monitoring program to study the effects of the operation of Pickering G.S.-A on the environment. Sections 6.1 and 6.2 and Table 6.21 outline the monitoring program to provide a continuing documentation of the effects of operation of Pickering G.S.-A as well as providing a basis for the analysis of the effects of Pickering G.S.-B.

Similar monitoring programs are being carried out independently by the Radiation Protection Service of the Ontario Department of Health and by the Radiation Protection Division of the Department of National Health and Welfare.

TABLE 6.20

REGIONAL SEWAGE AND WATER TREATMENT FACILITIES

Location	Type	Capacity Present	Future	Intake or Outfall Type and Location
Highland Creek Sewage Plant	Activated Sludge	16 MGD	64 MGD	42 in. dia. pipe to Highland Creek. Eventually extended to Lake Ontario.
Pickering Township Sewage Plant	Activated Sludge	1.25 MGD	2.5 MGD	36 in. dia. pipe extending 0.2 miles into Lake Ontario.
J. Sherman Scott Water Treatment Plant	Complete Treatment	10 MGD	–	30 in. dia. pipe 1812 feet into Lake Ontario. End crib in 18 feet of water.
Ajax Sewage Plant	Activated Sludge	2.5 MGD	–	48 in. dia. pipe to Duffin Creek.
Pickering Village Sewage Plant	Activated Sludge	0.4 MGD	–	Into Duffin Creek.
Ajax Water Treatment Plant	Complete Treatment	5.0 MGD	(15 MGD) Capacity Possible	36 in. dia. pipe 2100 feet into Lake Ontario.

Tracer studies, using tritium released during normal operations of the Pickering G.S.-A, will determine the dilution capability of the immediate and far-field areas. This study will also be used to determine any concentration levels in the local biota of the emitted radionuclides.

6.7.2 Non-radioactive Emissions

Hydrological, biological and water quality studies have been carried out at Pickering since the inception of the first four units to determine baseline conditions (Sections 6.1 and 6.2). Hydrological studies include:

(i) Recording of currents, direction and speed at the surface and at various depths.

(ii) Temperature measurements at various depths to determine seasonal and diurnal changes and the extent of the thermal plume under various local meteorological and station operating conditions.

(iii) Turbidity sampling offshore to evaluate groin effectiveness.

(iv) Soundings of lake bottom offshore from Frenchman Bay to determine any change in shoreline profile caused by changes in littoral drift due to intake groins.

(v) Physical laboratory model testing to measure groin effectiveness in controlling thermal recirculation and silt intake.

(vi) Theoretical plume modelling under a range of operating and climatological conditions.

TABLE 6.21

ROUTINE ENVIRONMENTAL MONITORING PROGRAM

SAMPLE	FREQUENCY	SAMPLING LOCATION	ANALYSES
AIR: a) Inhalation	Continuous Monthly	Not more than 5 molecular sieves samplers at site boundary	H-3
b) Immersion	TLD Dosimeters changed quarterly	Several at about 1, 5, and 15 km from site	Integrated quarterly gamma dose
	Integrating dose rate meter	At one suitable TLD site	Integrated quarterly gamma dose
PRECIPITATION	Quarterly composite of site buckets	About 5 precipitation buckets at site boundary and 1 at a reference background location	H-3 Gross β
MILK	Monthly in summer (April to October)	Composite of not more than 3 farms within 10 km of site	I-131 H-3
WATER a) Surface	Weekly Composite	Stations' circulating water effluent	Gross β
	Quarterly Composite	Stations' circulating water effluent	H-3; Specific radionuclides
b) Drinking Water	Semi-annual Composite	Municipal pump house if within 10 km of site	H-3; Gross β (specific radio-nuclides if $> 10^{-7}$ μC/ml gross β activity)
FISH	Twice a year	Near stations' outfall	Gamma spectrometric analysis

Water quality studies include:

(i) Temperatures, turbidity and dissolved oxygen in lake.

(ii) Further analysis at four locations in Frenchman Bay of pH, dissolved and suspended solids, phosphate, and nitrate, temperature, dissolved oxygen, and turbidity.

On-site biological studies during 1973 include:

(i) Measurements of fish populations and species in area.

(ii) Locationof fish spawning grounds.

(iii) Species and populations of benthic organisms at stations near the site.

(iv) Collection and identification of main taxa of phytoplankton and zooplankton.

(v) Shoreline surveys of filamentous algae and higher aquatic plants.

(vi) Chlorophyll A and phytoplankton analysis in Frenchman Bay.

These studies have been reviewed and approved by the Ministry of the Environment.

7.0 ENVIRONMENTAL CHANGES DUE TO CONSTRUCTION

The data presented in this section describes the influences of the project construction activities on the environment. Any influences will be superimposed on those caused by the operation of Pickering G.S.-A.

7.1 AIR

7.1.1 Quality

Air quality during construction should not be altered appreciably. Local on-site emissions will include dust and airborne particulates from excavation and filling operations and any rock crushing. Off-site sources will include airborne particulate matter generated by heavy traffic over roadways and dust produced by trucks transporting material on and off the station site. The airborne particulate produced on-site should not affect housing development to the northwest of Pickering G.S.-A, nor disrupt the planned park and recreation facilities to the northwest of the existing units.

Effects of off-site sources will be mainly due to trucks supplying ready mixed concrete. It is expected that heavy aggregate will be supplied from Quebec and brought by boat to Hamilton and then to the site. Light aggregate would most likely come from quarries in northern Pickering Township and be trucked to the ready mix concrete plants in Ajax. Dust may be produced along the four-mile route from the concrete mix plants to the Pickering construction site.

Open fires or incinerators for the burning of construction material are potential sources of particulate matter. Such operations will conform to the requirements of the regulatory agency.

7.1.2 Effects

Effects of atmospheric emissions generated on-site on the immediate area surrounding the property will be limited to particulates. Dust in the presence of free moisture will form a crust on surfaces of vegetation. Data have been documented (111) on the detrimental effect of dust on vegetation.

During the construction stage, the dust generated off-site along the trucking routes will be more of a nuisance than damage problem. The problem would be minimized by keeping roads near the plant free of heavy deposits and by using covered trucks where possible. Dust generated on-site should not cause damage off-site but may be a potential nuisance source to the operations staff of Pickering G.S.-A. Dust is not expected to influence public use of the new park area being developed northwest of the site. The site area had been cleared long ago of its original tree cover but some sugar maple, elm and beech are left along the lot boundaries and road allowances. Planted trees and remnant hardwoods and conifers interspersed with vacant grass lots are found in the residential area. Any effects will be visual and of a temporary nature.

7.2 WATER

7.2.1 Quality

Reclamation of land for the powerhouse area (Section 7.2.3) will absorb some of the excavated soil materials. Various areas on site for disposal of the remaining excavated material are being reviewed. Lake dumping of material, therefore, should not be extensive and

should only adversely affect existing water quality in a localized area. The proposed cooling water intake structures for the proposed station are described in Section 8. Dredgings from the condenser cooling water discharge channel area will be dumped in a lake location chosen for its minimal effect on water quality. During dumping some suspension of silt will occur within 1000 feet and have some slight temporary adverse effect on water quality. An investigation at Lennox G.S. (113) reviews the results of turbidity monitoring during a similar operation. Measurements indicate a local, short-lived suspension of dumped material. From this study it is concluded that lake dumping of dredged material in a controlled manner, will cause turbid conditions for a matter of a few hours after dumping within the immediate vicinity only. Release of nutrients to the water from the dredged material is predicted to be very small (113).

Sewage from all construction facilities will be piped through the interconnecting sewage system to the Pickering Township sewage plant.

Water quality effects due to water and alkaline flushing of constructed piping systems during commissioning are considered in Section 8.

7.2.2 Aquatic Life

Dredging, excavation and dumping during construction of the condenser cooling water discharge channel and the proposed offshore intake, will produce some suspended matter and dissolved nutrient materials in the waters adjacent to the operation. As discussed in 7.2.1, the impact of this operation was assessed at another site and the results indicate that no effects were observed (113). The Pickering site area is less biologically active than at Lennox so effects are predicted to be very small.

No other operations during construction of the station should be of significant magnitude to produce a marked impact on the aquatic life in the immediate area.

7.2.3 Flow Diversion

To provide necessary area for the proposed powerhouse yard and other facilities, an extension to the east of the existing reclamation will be required. The new shoreline will extend from the east limit of the present reclamation to the west boundary of the Pickering Township pumping station and about 400 feet into the lake. This new shoreline is expected to have only very slight effect on the lake current in the vicinity and the transport of littoral silt. Model studies are planned to study these factors.

7.2.4 Ground Water

The ground water level in the site area is generally high. In the area of the proposed excavation for the powerhouse yard, the ground water is located at about El. 260. Some form of dewatering system will be required to lower the water level to below excavation level to ensure that construction is in the dry. It is not expected that the ground water level within the excavation will be lowered more than 20 feet, so significant effect of ground water lowering will not be felt outside the site boundaries which are at least 3,000 feet away. The water level in the wet marsh on the far west side of the property should not be affected due to its distance from the excavation.

Contamination of ground water due to accidental spillage of fuel oil, cleansing fluid, etc., is considered to be negligible.

7.2.5 Surface Drainage

There is no local surface drainage system in this site. The surface run-offs and seepage encountered during construction will be taken care of by the artificial drainage system to be provided.

7.3 SITE AREA

7.3.1 Topography

The proposed switchyard is located on the relatively flat top of a drumlin so only minor grading will be required. In the proposed powerhouse area, the ground is gradually sloping from about El. 280 down towards the lake to about El. 268 at the top of the bluff. Part of the area has been graded down, but further grading will be required to bring the area to the design grade of El. 253.5. The top soil and the glacio-lacustrine silts will be completely removed as well as most of the layer of soft glacio till. No bedrock will be excavated. The possible exception is for the proposed alternate circulating water intake tunnel which may be through rock.

The till material excavated from the proposed powerhouse area will be used for reclamation offshore. The top soil and the glacio-lacustrine silts are not considered for this use, but may be used for landscaping purposes.

The area to be reclaimed extends from the east limits of the present reclamation to the west boundary of the Pickering Township pumping station property and about 400 feet into the lake.

7.3.2 Vegetation

The site area was cleared of its original tree cover and the land converted to agricultural use long ago. A few sugar maple, elm and beech are left along some of the lot boundaries and road allowances. During the construction of Pickering G.S.-A much of the construction site area was cleared of vegetation so only minor additional stripping is required.

7.3.3 Wildlife

Ducks are the most important wildlife resource along this section of the Lake Ontario shore (69). The ducks inhabit the various marshes in the area such as Second Marsh - Oshawa, Darlington Park, and other marshy areas such as Frenchman Bay, Cranberry Marsh and the mouth of such rivers as Duffin Creek and the Rouge River.

No marsh areas exist on the proposed site. Wildlife disturbed will be birds occupying the few remaining trees on site as well as mammals such as skunks, muskrats, mink, groundhogs, squirrels, mice, moles and shrews which are common to the area (17).

7.3.4 Rehabilitation

On completion of construction activity the site area will be graded and sloped. Flat areas will be sodded and shrubs planted. Trees will be planted on road access routes and slopes will be planted with shrubs. Parking areas and roads will be paved.

7.4 COMMUNITY AND LAND USE

7.4.1 Population

Table 6.17 shows 1971 population figures for the general zone around the Pickering site. Population projections up to a 15-mile radius are shown on Figure 17.

Only a small number of employees are expected to move into the immediate area due to the large labour market within easy commuting distance of the proposed construction site. The numbers involved will be negligible compared with the overall population growth predictions and would therefore have a very minor effect on population distribution.

7.4.2 Industry

The construction of Pickering G.S.-B would benefit some of the business establishments in the area due to local purchases by Hydro and by the families of Hydro personnel. Also more industrial concerns may be attracted to the area if the transportation network is improved to handle traffic to the new station.

7.4.3 Education

Educational facilities are expected to be adequate to absorb the requirements of construction families coming to live in the area.

7.4.4 Medical

The zone within ten miles of the site lies partially within Metropolitan Toronto, the centre of an extremely advanced provincial network of hospitals and other medical resources.

Station injuries that cannot adequately be treated at the first aid station will be sent by an ambulance, permanently stationed on the site, to Ajax-Pickering General Hospital. This has proven to be a satisfactory arrangement with the existing station. Also, facilities are available for treating victims of radiation exposure.

7.4.5 Transportation

Based on the existing transportation network, the largest pieces of equipment could be moved to the site by barge, and the remainder by road. However, use may be made of the railway siding being installed for the new Maintenance Centre (Figure 4 Section 4.6). Construction staff will use private cars, with most of the traffic approaching the site by Liverpool interchange, Bayly and Brock Roads. Local traffic would approach the site from both east and west by Montgomery Road.

With the anticipated industrial build-up along the main site approach road and the expected increase in traffic using the Liverpool interchange, unacceptable traffic congestion may result during peak hours. This could be alleviated by use of the railway siding, or extending this siding to the new station to handle most of the heavy transport requirements and also by encouraging use of the GO-Transit facilities by providing a bus service between the station and the site. Addition of a third lane to Brock Road would improve the traffic situation locally, and a new MacDonald-Cartier Freeway interchange at Brock Road would correct the otherwise extreme congestion at Liverpool Road.

Widening of Brock Road and a new interchange at the MacDonald-Cartier Freeway would be compatible with the M.T.R.C.A. conceptual plan for the Metro Toronto waterfront.

7.4.6 Labour Market

The Metro Toronto to Oshawa community has the capability of meeting the construction labour requirements. Some of the Ontario Hydro trades and supervisory staff would likely transfer from another project.

7.4.7 Recreation and Parkland

Public parks and recreational areas are beyond the actual site of the proposed station and should not be invluenced by construction activities. Wildlife sanctuaries along the lakeshore and recreational activities in the Frenchman Bay area would not be adversely affected.

Construction of the proposed station could be carried out concurrently with Metro's concept for waterfront recreational development without difficulty.

7.4.8 Historical Character

There are no features of historical interest on the site or its vicinity, other than the archeological "dig" two miles to the north. Also, the surrounding area is on the verge of large scale modern development as the Toronto-Centred Region expects 8 million residents by the year 2000 (as compared to 3.6 million in 1966). The proposed station would thus have minimal adverse effect upon the historical character of the area.

7.5 NOISE

Generally, the noise at a construction site can be classified into two categories: continuous noise, from diesel engines and impact noise from jackhammers, riveters and piledrivers. Overall sound pressure levels will depend on individual noise spectra of the construction equipment and the relative locations of different pieces of equipment at the site. During operation of certain pieces of construction equipment, the sound pressure levels in the work area could exceed 85 dBA. Since most construction will be at least 3000 feet away from the property line, the construction noise is not expected to intrude on the surrounding community.

7.6 TRANSMISSION

The proposed new lines will be constructed between the two existing 230 kV double-circuit lines which are on each side of the right-of-way.

There are existing construction roads down the right-of-way from the main roads. Line construction probably will not create any disruption of traffic except during stringing operations.

8.0 ENVIRONMENTAL CHANGES DUE TO OPERATION

8.1 AIR

8.1.1 Quality

8.1.1.1 Radioactive Gaseous Emissions

During normal station operation any continuous release of radioactivity to the environment will be via short stacks. In the case of purges of areas having closed ventilation systems, the ejected atmosphere will be released to the environment via these stacks. In all cases, the potentially radioactive effluent is monitored and if necessary, filtered, or retained by closing the exhaust duct dampers.

It is possible to postulate the amount of radioactivity that may be released from the proposed station based on operating experience with Pickering G.S.-A.

Section 6.0 data on the operation of Pickering G.S.-A may be applied to the proposed station. Figure 6 indicates that the operation of Pickering G.S.-A has not measurably changed the gamma radiation background in the area. The proposed station will be designed to conform with 1% of DRL's. Area monitoring will be carried out to ensure conformance with regulations and to detect any measurable additions to the background radiation levels due to the operation of the proposed station.

Further information regarding operating experience at Pickering G.S.-A (112) indicates what the expected average release rates for Pickering G.S.-B would be as shown in Table 8.1. The effects of the above postulated activity releases to the atmosphere are outlined following.

8.1.1.2 Effects

In determining possible effects of released radioactive nuclides, it is instructive to compare margins between actual emissions to the atmosphere and the maximum allowable. It is recognized that the legal limits apply to an entire site; therefore, the releases from Pickering G.S.-A must be added to the anticipated releases from the proposed station.

Based on the data presented in Table 5.2, which lists maximum permissible concentrations of various nuclides in respirable air for continuous exposure, it is possible to determine the maximum permitted continuous release rates (DRL's) for these nuclides (Table 8.1).

Comparing the expected releases from Pickering G.S.-B (Column 4, Table 8.1) to the maximum perimissible, it can be seen that anticipated releases to the atmosphere, prior to the installation of further gaseous clean-up systems, are small fractions of the maximum allowable.

Meeting of the design targets of 1% of DRL's will ensure that the above margins are maintained or improved upon on a yearly basis.

8.1.1.3 Non-Radioactive Emissions

The 6 gas turbines of 7.5 MWe capacity each are expected to be used in the same manner as the existing turbine units. They will use light distillate oil (0.5% sulphur) and operate approximately 500 hours/year total. Most of this time will be for routine testing on a regular basis to ensure the units are always operable for their prime function, namely, black start capability. The units also have the potential to provide peaking power if required.

TABLE 8.1

TARGET 7-DAY RELEASE RATES FOR GASEOUS RADIOACTIVE ELEMENTS

Radionuclide	MPCa (Ci/m^3)	DRL (Ci/7 days)**	Design Target *** 1% of DRL (Ci/7 days)	Expected released rates**** (Ci/7 days)
I-131	6×10^{-13}*	4×10^{-1}	4×10^{-3}	$<7 \times 10^{-3}$
H-3	3×10^{-7}	2×10^{5}	2×10^{3}	$<7.0 \times 10^{2}$
Particulates	1.5×10^{-12} Ci-Mev/m^3	1.0 Ci-Mev/7 days	1.0×10^{-2} Ci-Mev/7 days	$<7.0 \times 10^{-4}$ Ci-Mev/7 days
Noble Gases	6.4×10^{-8}	4.3×10^{4}	4.3×10^{2}	$<2 \times 10^{3}$

* Based on ICRP recommended dose of 1.5 rem to child's thyroid-uptake via food chain, open grazing of dairy herds 6 months per year.

** Based on a dilution factor at site boundary of 9×10^{-7} sec/m^3

*** Actual averaging period for 1% DRL design target is one year. 1% DRL/7 days is shown strictly for comparative purposes.

**** Release rates assume no off-gas management system installed, based on Pickering G.S.-A experience to date.

The tentative location of these units indicates that the low level emissions will not interact with emissions from the existing units, since they are over 1000 feet apart.

The units will be designed to meet regulatory requirements and ground level concentrations of atmospheric emissions will be well within regulatory limits.

8.2 WATER

8.2.1 Thermal Discharge

8.2.1.1 Modifications to Thermal and Current Regime

Cooling water for the existing and proposed stations will be supplied by either (a) a single tunnel, approximately 6000 feet out into the lake, the intake being in 50 feet of water or (b) a channel extending out into the lake formed by the groins now under construction (Section 4.7.3). The proposed station discharge will be to a channel directing the plume to the SE from the eastern edge of the proposed powerhouse (Figure 19). As with the existing station, local natural and wind induced currents will be modified in the immediate plume area. Investigations of the extent of thermal plume effects (13) have shown that temperature increases and momentum-induced currents for a 2-unit station dissipate within approximately one mile of the station. Recent on-site investigations show only minor extensions for 3-unit operation (108).

Shoreline currents from the east, which have caused silting problems in the intake channel, forebay, condensers and discharge channel of the existing station, should be deflected out into the lake by the proposed station surface discharge. The offshore intake is not expected to recirculate any silt carried offshore by the discharge (Section 6.2.4).

Vertical temperature profiles off the Pickering site (13) indicate the buoyancy of a surface discharge (Section 6.2.3.2). Recirculation of heat in the winter due to the sinking of the heated plume has been shown to occur at a generating station on Lake Michigan (104). During the months of March and April, sensors placed at various positions in the discharge area recorded evidence of the sinking plume 2% of the time at approximately 5000 feet from shore with temperatures up to 5F° higher than at the intake. Based on this study it is expected that though the recirculation problem at Pickering G.S.-A caused by onshore winds and a shoreline intake should be alleviated, recirculation is possible to a limited extent during those months of the year in which the ambient lake temperatures are 4°C or lower.

Figure 19 shows the predicted average surface plume areas on a seasonal basis, with the alternative tunnel intake. Thermal modifications are predicted for up to approximately two miles from the two discharge channels under the prevailing wind and current conditions in the summer, winter, spring and fall seasons at full load. The project area occupied by the thermal discharge at a depth of 10 feet and 5F° above ambient is expected to be reduced to one tenth (13). With the alternative open channel intake the surface thermal discharge areas will be slightly larger in the summer due to loss of benefit from low temperatures at depth. The physical model studies now in progress (Section 6.7.2) will investigate the effectiveness of the groins to minimize thermal recirculation, after which time the decision will be made on the type of intake to be constructed for Pickering G.S.-A and B.

In Frenchman Bay, temperatures have been monitored since 1970 to determine if the thermal regime will be altered. During two unit operation of Pickering G.S.-A in 1972, no increase in temperature over 1971 was observed (108). The location of the proposed station discharge is such that any thermal influences in the Bay will be much less than any due to the existing station discharge.

TABLE 8.2

TOLERANCE LIMITS AND PREFERRED TEMPERATURES (^{o}F) FOR SOME TYPICAL FISH SPECIES IN THE SITE AREA

Species	Acclimation Temperature	Upper Critical Temperature	Final Preferendum	Ref
Alewife	59	73	–	(49)
Yellow Perch	41	70	–	(50)
Yellow Perch	50	77	–	(50)
Yellow Perch	59	82	–	(50)
Yellow Perch	77	85	76	(50)
Carp	69	93	90	(52)
Carp	79	96	90	(52)
Gizzard Shad	77	93	–	(50)
Gizzard Shad	86	97	–	(50)
Gizzard Shad	95	99	–	(50)
Sunfish	50	82	–	(49)
Sunfish	86	95	89	(49)
Smelt	–	71-83	–	(51)
Rainbow Trout	–	78	57-64	(54)
Brown Bullhead	50	86	–	(55)
Brown Bullhead	86	99	–	(55)
Spottail Shiner	41	81	–	(50)
Spottail Shiner	77	88	–	(50)
Spottail Shiner	86	88	–	(50)
Coho Salmon	–	77	–	(53)
White Sucker	41	79	–	(48)
White Sucker	50	82	–	(48)
White Sucker	59	84	–	(48)
White Sucker	68	84	–	(48)
White Sucker	77	84	–	(48)
White Perch	60	87	69-75	(105)
Common Shiner	41	80	–	(48)
Common Shiner	50	84	–	(48)
Common Shiner	59	89	–	(48)
Common Shiner	68	88	86	(50, 48)
Common Shiner	77	88	86	(50, 48)
Smallmouth Bass	68	90	–	(50)
(Juvenile)	–	–	82	(109)
Rock Bass	–	–	58-70	(110)

8.2.1.2 Ice

With a surface discharge, the 20-30 foot strip of shore ice east of the station will disappear. There is no other extensive ice cover in the Pickering site area. Periodically, from early January to mid March, on-shore winds can bring in ice floes from the main lake area (8). The thermal discharge to the east should keep the immediate area clear during these temporary ice cover conditions.

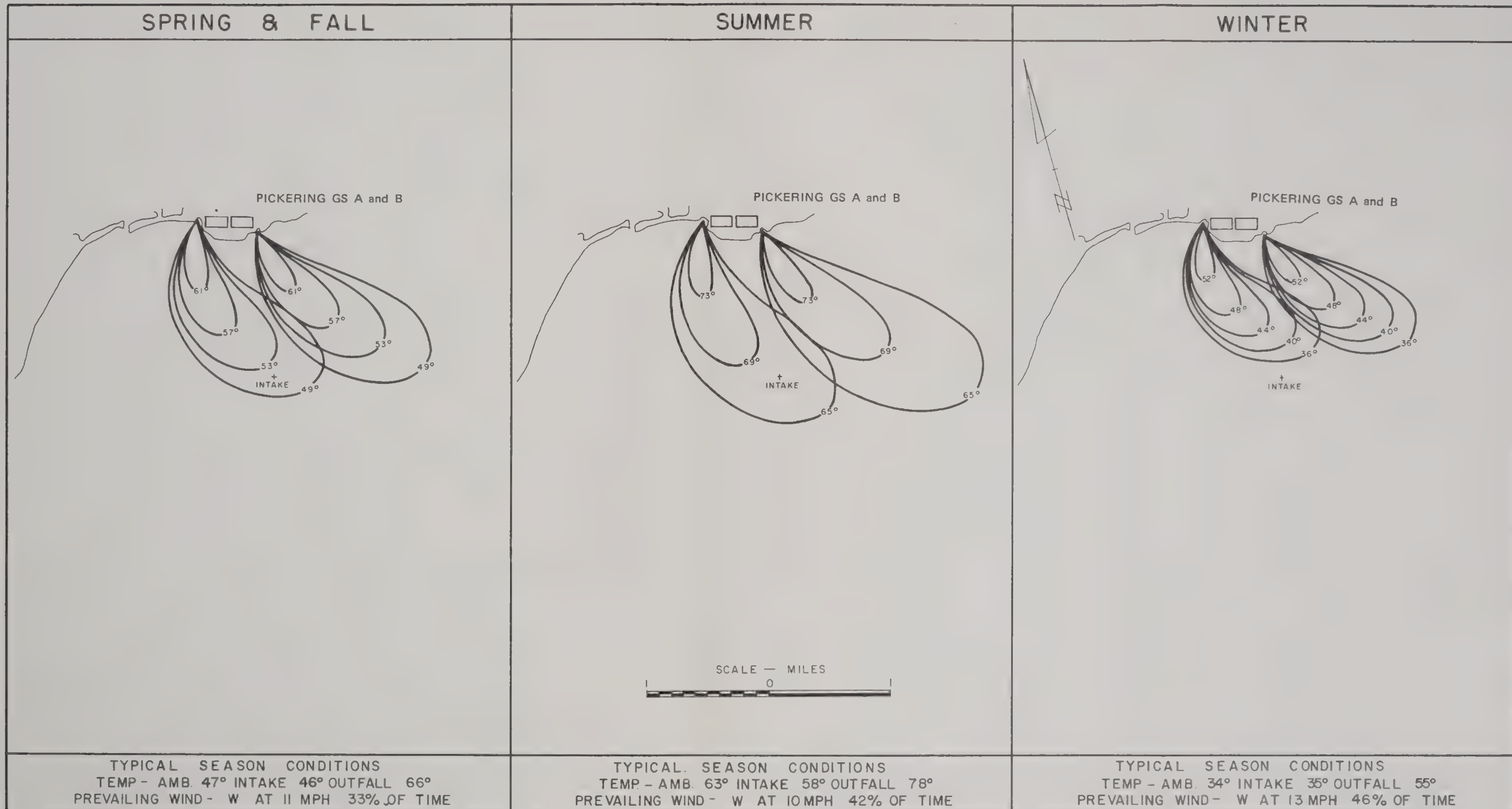


FIGURE 19 LAKE SURFACE THERMAL PLUME PREDICTION EAST AND WEST OUTFALLS – TUNNEL INTAKE

8.2.1.3 Water Quality

(a) Dissolved Oxygen

In the vicinity of the site, dissolved oxygen levels are not considered to be a factor limiting the maintenance of a diversified aquatic community. During the passage of water under partial vacuum through the condensers, it is not expected that large volumes of released gases will be withdrawn. Levels of dissolved oxygen are the result of thermodynamic factors such as gas solubility and kinetic processes such as rate of oxidation of organic matter (BOD), rate of oxygen uptake by the sediments, photosynthetic acdivity, and rate of reaeration, each of which shows slight temperature dependencies. Predictions that thermal discharges would significantly lower the dissolved oxygen concentrations in low-BOD waters are generally not substantiated by data from recent studies (73)(74). Dissolved oxygen in the thermal plume area of an existing station on Lake Ontario was found to be similar to levels at the discharge point (75).

(b) Biochemical Oxygen Demand (BOD)

A body of water containing organic wastes may have adequate amounts of oxygen to maintain desirable fish life at one temperature, while at an elevated temperature the BOD would be increased sufficiently to cause a critical depletion in dissolved oxygen. Such a condition would occur only if two other factors are also present: the intake waters of the power station must have an organic load, such as when large amounts of untreated municipal and/or industrial wastes are discharged adjacent to the intake, and the elevated temperatures must persist for periods of many hours to days. These two conditions will not occur at the proposed station and therefore the existing water quality is not expected to measurably increase the oxygen demand brought about by the transient elevated temperature in the thermal discharge area (73, 76, 77).

(c) Nutrient Recirculation

If nutrient-rich water is exposed to elevated temperatures and sunlight, high algal productivity reaching bloom proportions may result. At this site, water quality does not change markedly with depth. Levels of 0.3 ppm total nitrogen and 0.01 ppm phosphorus are regarded as typical critical concentrations above which algal blooms may occur (78). Even lower levels have been measured in waters supporting algal growth. At this site, concentrations of both nitrogen and phosphorus are in the range quoted for waters having potential for algal bloom formation. However, concentrations of algae taken offshore should not provide an adequate inoculum for producing bloom population levels during the relatively short period of elevated temperature in the discharge area, particularly as the thermal shock may delay or inhibit photosynthesis and growth (80). Dissolved oxygen levels in the intake area are well above the level of 1 ppm below which bottom sediments give up nutrients which would promote algae growth (79,107).

Entrained organisms may release nutrient materials to the discharge area which would encourage the growth of heterotrophic slimes on structures near the discharge point.

(d) Chlorine

Assuming that the most extreme exposure conditions are when eight condenser halves are chlorinated sequentially, the discharged cooling water will maintain a maximum concentration of 0.06 ppm for a period of 160 minutes. Toxic residual chlorine or chloramine levels for this exposure period have been documented to be in the range 0.1 - 1 ppm for such sensitive fish species as trout (81-88), yellow perch (89) and small mouth bass (84). No

adverse influences on the fish are therefore predicted using this dosage schedule. Slightly higher peak levels of residual chlorine may occur during periods when fewer than four units are operating, but the continuous dosing period will be correspondingly reduced.

No evidence of deaths attributable to chlorine has been obtained after two years observations at three Ontario Hydro stations (47).

8.2.1.4 Aquatic Life

(a) Thermal Effects on Fish

Fish are cold-blooded and therefore at higher temperatures metabolic rates increase. In normal station operations, the area influenced by the thermal discharge changes with the operating load of the station. In addition, the thermal plume tends to move about under the influence of wind and currents. Resulting changes of area, position and temperature appear to be such that prolonged residence of fish in the thermal discharge is discouraged. On-site observations at other lakeshore stations have indicated that most adult fish species will select their preferred temperature range and as a result move freely in and out of the areas influenced by a thermal discharge (47).

Results from the 1971 biological studies at the Pickering site (21) indicate that catches netted in the thermal plume were larger in spring and late fall, while catches in the control location were greater in the summer and early fall. In 1972, fish populations were again higher in the discharge area in the spring and fall. In the summer months, July-October, populations were higher in the discharge area when the station was not operating. The highest population was found in September when the CW pumps were operating but there was no heat being discharged (107). Fish taken from the thermal plume and control areas showed no general physical differences. Fish in the thermal plume appeared to have been feeding normally. From the data presently available it is predicted that there will be no measurable direct thermal influence on fish occurring in the area. With the offshore intake, discharge temperatures will be lower due to the slightly lower intake temperatures occurring at depths during the summer and fall.

Some of the species common to the area have tolerance limits and preferred temperatures as shown in Table 8.2. These data suggest that the commonly occurring smelt and yellow perch may be adversely influenced if attracted to the thermal discharge and remain in water whose temperature is higher than their final preferenda. Coho salmon which occur in low numbers in the area, may be similarly affected if attracted and retained in the discharge area.

The time for 50% of a given fish species population to die at an extreme temperature, T (°C), can be calculated from the regression equation

$$\text{Log } t = a + bT \qquad \text{equation 1} \quad (90, 61)$$

where a and b are the intercept and slope respectively of the graph log t vs T, t being the exposure time, in minutes. The values of a and b are species-dependent, and are influenced by the acclimation temperature for each extreme temperature exposure. Several studies have confirmed that temperatures at which no mortalities occur for similar exposure times are, on an average, 2C° below the upper critical temperature. The equation may therefore be modified to calculate exposure times at which no mortalities will occur for a given upper critical temperature

$$\text{Log } t = a + b(T + 2) \qquad \text{equation 2}$$

Transposing equation 2

$$1 = \frac{\text{Log } t}{a + b(T + 2)} \qquad \text{equation 3}$$

When the right hand side of equation 3 exceeds unity, the fish species will be exposed to times or temperatures which may cause thermal death. Table 8.4 presents data for critical species in the Pickering area.

Table 8.3 summarizes the available experimental data on some fish species found at the site for solution of equation 2. Using these data, Table 8.4 calculates the value of the quotient in equation 3 for each month of the year, using the maximum temperature rise across the plant and mean monthly intake temperatures. Included also are the values due to exposure to the highest recorded daily mean temperature of the year. These calculations indicate that at all times of the year, each of these fish species could tolerate passage from ambient lake surface temperatures to the immediate discharge point. Yellow perch may be adversely influenced if temperatures go higher than the maximum presently recorded for September, although there is evidence that this species avoid outfall areas (92).

Death of fish due to elevated temperature near a generating station is not a common occurrence (56, 114, 115), but there are records of death when plant .utdown exposes fish to a rapid drop in temperature (57). It is not likely that extreme temperature fluctuations will occur because the sudden shutdown of all four units at the same time is a remote possibility.

(b) Fish Spawning & Migration

The temperature requirements for reproduction and egg development in many species are confined to narrower ranges than for other physiological functions (58)(59). Photoperiod effects and rising temperatures in the spring induce development of the gonads, and actual spawning is induced when a certain temperature range is reached. Generally, low temperatures during pre-spawning periods delay spawning, and higher temperatures hasten it (58,60). Fish attracted to and retained in discharge channels may be induced to spawn earlier than might otherwise be expected (61).

The proposed station, will be designed to have a low velocity thermal surface discharge. Thermal plume investigations at Pickering G.S.-A (13) (sec 6.2.9) indicate that surface temperatures decrease to within 1F° of ambient temperatures at approximately 10,000 ft (2 miles) of the discharge outlet. Vertical temperature profiles indicate that the temperature at 20 feet was close to ambient in all areas outside of 2000 feet from the discharge. During periods of onshore wind the plumes will tend to follow the shoreline. The thermal discharges from the proposed Pickering G.S.-B and Pickering G.S.-A are not expected to overlap except in the surface layers (Figure 19). Since the thermal profile is much smaller at depth, and the plumes constantly move with shifts in winds and currents, the effect of the additional thermal plume is expected to have a very slight influence on the natural shoreline thermal regime.

As outlined in 6.2.7.1, known local spawning areas include Duffin Creek (2 miles east), Frenchman Bay (1 mile west) and the Rouge River (3 miles west). It is not expected that the thermal discharge will influence the temperatures at these points such that upstream migration is prevented. Existing data on fish intake however, indicate that some smelt and alewives are prevented from completing their spring migration. This loss of migrating fish is expected to be considerably reduced by the use of an offshore intake.

(c) Benthic Organisms

Ontario Hydro studies begun in October 1970 include determinations of the diversity and abundance of benthic organisms before and after the thermal and hydraulic regimes were altered due to the operation of Pickering G.S.-A. The study is planned to continue through 1974 or until such time as conclusions can be made. The above study (21) and a similar one at Lakeview G.S. (37) indicate similar species diversity and population densities to nearby control areas not influenced by the discharge. The 1972 data (107), complicated by station shutdown, indicates a slight average reduction in numbers of taxa at the station closest to the thermal discharge point, but overall numbers of organisms collected for the same period were higher. During the period of station shutdown, numbers decreased at this one station over the equivalent period in 1972. Based on these data it is predicted that thermal effects in the area influenced by the discharge will be small.

Some scouring and redistribution of the lake bottom sediments would be expected to occur in the near-shore discharge area. If the offshore intake results in a low silt intake it is predicted that rapid recolonisation of the discharge area will occur after the bottom sediments are stabilized.

(d) Plankton

For plankton not entrained in the condenser cooling water but influenced by the thermal discharge, there will be a localized shift at the warmer times of the year from a diatom-dominated to a green algae-dominated population. The limitation of discharge temperatures to a maximum of 90°F is not expected to cause significant production of blue-green forms. This is substantiated by visual observations made during the last two years of on-site studies in the thermal discharge area (21, 107). It is not expected that algal blooms will be produced because the hydraulic momentum will limit the residence time of plankton in the area influenced by the thermal discharge.

(e) Filamentous Algae and Rooted Aquatic Plants.

Observations in the thermal discharge area of other generating stations on Lake Ontario have revealed little or no obvious increase in the total algal biomass (37)(38)(39). At the Pickering site, both the growth and fragmentation period of the attached algae, Cladophora, are expected to take place approximately one month earlier in the immediate discharge area. Growth may increase in those areas influenced by currents, but an increase in temperature is expected to have little or no effect. Temperatures favourable for growth in the discharge area during winter and spring will not lead to accumulation of attached algae as lower light levels and reduced day lengths become the limiting factors (39).

(f) Entrainment of Organisms

Organisms entrained in the cooling system will include phytoplankton, zooplankton, the free-swimming larvae of benthic invertebrates, fish eggs and larvae, and young fish. In addition to temperature shock, there will be mechanical abrasion and pressure change effects. They will be subjected to a maximum temperature rise of 19F°.

Tests carried out at generating stations with once-through cooling system have shown that for temperatures below 94°F, little or no reduction in species composition of phytoplankton was observed (40,41). Zooplankton passing through power station cooling systems showed no increase in mortality when subjected to a maximum temperature of 88°F and a temperature rise of 18F° (42).

Photosynthesis inhibition has been measured in phytoplankton when temperatures were raised from 73.4°F to 87.4°F (43). Some loss of mobility of zooplankton will occur but responses are variable (42,44). Small fish and various motile larval forms will not be able to move against the approach velocity at the intake and will therefore be drawn into the intake structures.

Juvenile stripped bass have survived passage through a condenser cooling system with a temperature rise of 16F° and a 2-3 minute exposure (45). In a power station cooling system with a Δ T of 22.5F° and a flow-through time of 93 seconds the entrained larvae of fish including alewives, herring and shad were killed. Fish small enough to pass through the screens would be killed by exposure to temperatures above 85°F for more than a few minutes (46).

The change of intake structure from the present surface intake to a common offshore intake for the existing and proposed stations should decrease the entrainment of fish. At Nanticoke G.S. on Lake Erie, operating at approximately one third of the flow and approach velocity, but which has a tunnelled intake, reports peak spawning season entrainment of fish at only one percent of the level of the existing Pickering G.S.-A figures during a similar period. Typical average values for the remainder of the year would be in the same order as for the existing Pickering G.S. -A (Section 6.2.6.1).

Entrained fish which are too large to pass through the screens will be removed by the conventional screening system. Impingement on the screens and subsequent handling procedures will result in loss of fish. They will be gathered with weeds and other materials removed by the screens. The low designed approach velocity of 1 ft/sec is expected to avoid entrainment of large fish.

8.2.2 Miscellaneous Discharges

8.2.2.1 Radioactive Liquid Emissions

Because all liquid effluent from the station which might conceivably contain significant activity will be closely monitored and contained, it is extremely unlikely that the effluent will ever contain more than the allowable limit for continuous release during normal operating conditions. The maximum permissible doses for the public are such that the monthly average gross beta/gamma concentrations in all station liquid effluents should not exceed 3.0×10^{-13} Ci/ml. Short term release should not exceed 3.0×10^{-12} Ci/ml.

Data from the operating Pickering units (Sections 6.1 and 6.2) regarding releases up to May 1972 may be applied to the proposed station. Table 6.9 lists the radionuclide concentrations in the CW effluent for the period January 1972 to June 1973. The composite concentrations for January 1972 to June 1973 were 1.17 x 10-12 Ci/l for gross beta activity and 0.80×10^{-9} Ci/l for tritium; the MPC_w's are 300×10^{-12} Ci/l and 5500×10^{-9} Ci/l, respectively. From the other relevant tables in Section 6 it appears that the background level of radiation in water has been little affected by the operation of Pickering G.S.-A.

8.2.2.2 Effects

The composite concentrations of activity in the CW effluent as indicated above are approximately 0.01% of the allowable limit for tritium and 0.39% of the limit for gross beta. These composite concentrations are presently below the design targets of 1% of the DRL's. Pickering G.S.-B should demonstrate equally good, if not better performance.

8.2.3 Conventional Miscellaneous Discharges

8.2.3.1 Standby Generators

The fuel oil supply tanks will be dyked such that if either tank is breached the contents of the tank (plus 20%) will be contained and not overflow to the lake.

Leaks from the fuel supply system feeding the generators will be collected and drained to a central underground storage tank.

8.2.3.2 Lube Oil Storage Tanks

Oil from leaks and filling operations will be collected. A possible method now under investigation uses an oil interceptor and polyurethane/charcoal filter. The resultant purified water at less than 15 ppm oil would be sent to drain.

8.2.3.3 Water Treatment Plant

An additional demineralization line will be added to the existing water treatment plant to supply demineralized water.

Clarifier blowdown will be routed to the settling basin where suspended solids can settle out. The supernatant will overflow to the neutralizing sump, be analyzed and then metered into the condenser cooling water (Section 4.7.4.5).

8.2.3.4 Phosphates

Station liquid waste streams will be monitored for radioactivity and phosphate levels. If the level of contained radioactivity is such that release is permitted, the liquid stream containing phosphates from the showers will be released to the Pickering Township sewage system.

If the level of radioactivity is such that dilution is required, the liquid waste will be mixed with and diluted in the CW effluent. The amount of phosphates released via this method at Pickering G.S.-A over a 242 day period from August 1972 to March 1973 was equivalent to 0.25 lb/day as phosphorus (100).

Waste liquid with a very high radioactive or chemical content may either be purified in station or solidified in concrete for off-site disposal.

8.2.3.5 Commissioning Flushing

It is expected that morphaline and hydrazine will be added to demineralized water for flushing of each unit during the commissioning period. The Ministry of the Environment will be consulted on disposal methods in order that the impact on the aquatic environment may be minimized.

8.2.4 Ground Water

Ground water levels disrupted during the construction phase will remain permanently lowered in the powerhouse area. All other areas will be modified to varying extents depending on the amount of excavation required in the area. Lowering of the ground water levels in the area of the proposed powerhouse will not affect other facilities on the site.

8.2.5 Surface Drainage

The artificial surface drainage system created for Pickering G.S.-A will be extended to accommodate drainage in the Pickering G.S.-B area. All drainage will finally be discharged to the lake.

8.2.6 Water Use Compatability

8.2.6.1 Industrial

There are no known industrial water intakes in the immediate vicinity of the site. Any modifications to the normal thermal regime or to the physical and chemical characteristics of the water are therefore not expected to have an influence on existing industrial water users. There are no persistent or irreversible changes to the water quality which are considered to be of potential concern to other industries which may locate closer to the site.

8.2.6.2 Public

The closest municipal water intake is the J. Sherman Scott intake immediately to the east of the proposed site area. The pipe extends 1200 feet into the lake, with the intake in 18 feet of water. This position would be within the area occupied by the condenser cooling water discharge. Studies are being carried out by Ontario Hydro and the Provincial Government to determine the optimum location of this municipal intake to avoid affecting the normal water quality provided to Pickering Township. One proposal made to the Township has been to relocate the intake to the common forebay of Pickering G.S.-A and B. Long range municipal plans for the area may call for the relocation of the J. Sherman Scott water treatment plant.

Water quality in Frenchman Bay is being monitored and has not undergone any measurable change in the period 1970-1972 (107). Towards the end of 1972, two units of Pickering G.S.-A were operating. Due to the location of the proposed station outfall relative to the Bay it is expected that thermal influences if any, will be considerably less than any due to the existing station discharge.

8.2.6.3 Water Resources

Irreversible loss of water from the area will be confined to an increased rate of evaporation during cooling of the thermal discharge.

8.3 SITE AREA

8.3.1 Vegetation

Most of the area vegetation will be removed in the immediate powerhouse area during construction of the proposed station. Grading, sodding and planting of shrubs and trees on banks, along access routes and in open areas will be carried out as part of the landscaping program for this project.

8.3.2 Wildlife

Some wildlife disturbed during construction is expected to return to less populated areas of the new station site.

TABLE 8.3

DATA SUMMARY FOR SOLUTION OF FISH TIME-TEMPERATURE EXPOSURES

Species	Acclimation Temperature (°F)	Upper Lethal Threshold (°F)	a (90)	b (90)
Yellow Perch *(Perca flavescens)*				
Adults	59	82	12.4149	-0.3641
	68	85	16.9037	-0.4801
	77	85	21.2718	-0.5909
Juveniles	66	—		
Brown Bullhead	59	88	28.3281	-0.8239
(Ictalurus nebulosus)	77	93	22.4970	-0.5732
	86	95	24.2203	-0.5917
Common Shiner	50	84	40.7738	-1.3522
(Notropis cornutus)	59	86.5	45.0972	-1.3874
	68	88	34.5324	-1.0116
	77	88	24.9620	-0.6878
White Sucker	41	79	33.6957	-1.1797
(Catostomus	50	82	19.9890	-0.6410
commersonii)	59	85	31.9007	-1.0034
	68	85	27.0023	-0.8068
	77	85	22.2209	-0.6277

8.3.3 Shoreline

The powerhouse area for the proposed station will be located on land created by fill excavated from other parts of the site. Aquatic life will therefore be eliminated from this filled area. The discharge of water at the end of the proposed station discharge channel will initially erode the fine lake bottom sediments, but this effect is expected to be of short duration.

8.4 COMMUNITY AND LAND USE

Two hundred additional personnel will be required to operate the proposed station, most of whom will come from the immediate vicinity. Traffic problems will be alleviated when transportation of heavy equipment diminishes and the peak number of construction employees falls off near the end of the construction phase. Educational requirements will be reduced when most of the imported construction and supervisory staff move out of the area. Proposed new recreational facilities will by then be either complete or under development. Housing for the extra operational staff will be acquired in the surrounding communities.

TABLE 8.4

PREDICTION OF MONTHLY TIME-TEMPERATURE EXPOSURE EFFECTS ON SOME TYPICAL FISH SPECIES

	MEAN MONTHLY * TEMPERATURE (^{o}F)		QUOTIENT $\frac{\log t}{a + b\,(T + 2)}$				
	DISCHARGE	SURFACE	YELLOW PERCH	BROWN BULLHEAD	LARGEMOUTH BASS	COMMON SHINER	WHITE SUCKER
Jan	53	33	0.0000	0.0000	0.0000	0.0000	0.0000
Feb	53	33	0.0000	0.0000	0.0000	0.0000	0.0000
Mar	54	34	0.0000	0.0000	0.0000	0.0000	0.0000
Apr	58	38	0.0000	0.0000	0.0000	0.0000	0.0000
May	63	46	0.0000	0.0000	0.0000	0.0000	0.0000
Jun	65	51	0.0010	0.0000	0.0000	0.0000	0.0000
Jul	68	54	0.0036	0.0000	0.0000	0.0000	0.0000
Aug	74	62	0.0300	0.0000	0.0000	0.0000	0.0000
Sep	73	59	0.0833	0.0000	0.0000	0.0000	0.0000
Oct	66	48	0.0025	0.0000	0.0000	0.0000	0.0000
Nov	65	44	0.0000	0.0000	0.0000	0.0000	0.0000
Dec	56	37	0.0000	0.0000	0.0000	0.0000	0.0000
Aug/Sep**	81	70	0.9300	0.0100	0.0030	0.0010	0.0111

* Based on 1972 Readings &Hydraulic Studies Department, unpublished data, Ontario Hydro)

** Maximum daily mean temperature

Discharge Temperature = Intake Temperature +20F^{o}

8.4.1 Population Dose Calculations

Section 5.1, Radiation Exposure Regulations, notes that the AECB specifies population dose limits for normal operation (routine operation plus single failure accidents) as well as individual dose limits. The population dose limits are:

10^4 man rem whole body exposure,

10^4 thyroid rem or exposure of 10 $\frac{\text{thyroid-Ci-Sec}}{\text{m}^3}$

8.4.2 Routine Releases

It is necessary to determine whether, during operation, the population dose or the dose to the most susceptible indivdual at the boundary would be limiting with respect to permissible radioactive releases from the station. In the following calculations it is assumed that there is no contribution to the dose from single failure accidents.

For routine releases, it is necessary to consider the population whole body dose received rather than the population thyroid dose. The reason for this is that the release of thyroid irradiators is governed (for routine releases) by the individual dose received by a child via the milk chain; this limit is two orders of magnitude lower than the corresponding limit if only inhalation is considered. Therefore, if it is assumed, as it must be, that a child at the site boundary receives the maximum thyroid dose via the milk chain, then the integrated population thyroid dose would be a small fraction of the allowable limit because the majority of the population would receive its thyroid dose via inhalation.

To calculate the population dose, it is necessary to know the population around the Pickering site.

Table 8.5 lists the population figures in four mile annular segments around the site for 1970 and predictions have been made for 1986 and 2001. Figure 20 indicates the atmospheric dilution factor, as a function of stack height and distance from the source, to be used in calculating population doses. The effective stack height at the station is assumed to be zero metres (ground level release) and it is assumed that an individual at the site boundary just receives the maximum permissible annual dose (0.5 rem whole body). Integrating the population dose based on 2000 feet annular segments out to the lower limit of integration (dose received = 1/100th the dose at boundary = 0.005 rem, see Section 5.0) results in the following predicted population doses:

(i) in the year 1986 - 11,120 man rem

(ii) in the year 2001 - 18,290 man rem

These figures indicate that around 1985, if the actual population is the same as the predicted population, the population whole body dose limits for continuous release would become limiting rather than the individual whole body dose limits.

It has been argued (116) that the effective stack height at the station is 20 meters rather than 0 meters and if this is so, then the population dose limit may become limiting before 1985. The reason is that a larger population must be included in the population dose integration because the lower limit of integration occurs at a greater distance from the station than in the case of a 0 meter effective stack height.

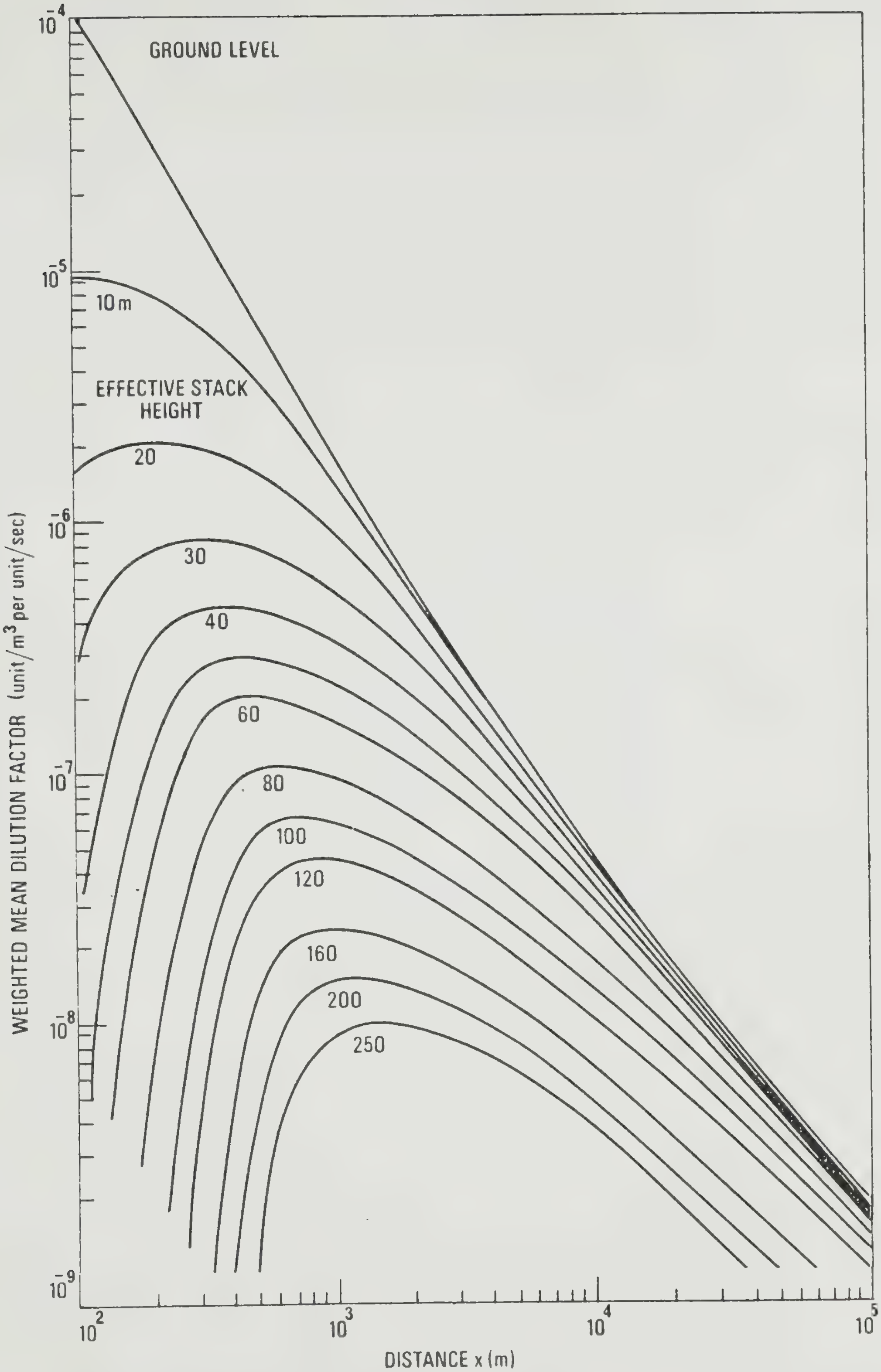


FIGURE 20 WEIGHTED MEAN DILUTION FACTOR FOR CONTINUOUS RELEASE

The above points out the need, which Ontario Hydro recognizes, of re-evaluating on a regular basis, based on actual population figures, population doses which might be received in the vicinity of the Pickering site.

Meeting the design targets (Section 3.3) will insure that neither the individual nor the population ose limits will be exceeded during the life of Pickering G.S.-A and B.

8.5 NOISE

It is most unlikely that noise emanating from the station to the surrounding community will exceed the normal background levels. One exception would be the occasional operation of steam relief valves on the roof during certain shutdown sequences. Silencers have recently been developed and tested that are expected to reduce noise from this operation to below 50 dBA and will be installed at the proposed station.

Various measures to be taken to reduce noise levels for the protection of operating staff within the plant may also produce a slight reduction in noise level transmitted to the site boundary.

TABLE 8.5

POPULATION FORECASTS

MILES FROM PICKERING SITE	1970	1986	2001
0-4	42,000	94,000	157,000
0-8	140,000	380,000	635,000
0-12	390,000	960,000	1,540,000
0-16	860,000	1,815,000	2,770,000
0-20	1,600,000	2,835,000	4,010,000

8.6 TRANSMISSION

8.6.1 Egress

For the duration of the life of the proposed station, the egress will be maintained so as not to interfere with the transmission of electrical energy produced by the proposed station. This maintenance will be mainly tree-pruning and landscape maintenance.

8.6.2 Right-of-Way

The existing right-of-way width is 500 feet and is planned to contain the two existing 230 kV double-circuit lines and two additional 230 kV double-circuit lines. The present right-of-way is adequate for bulk power transmission when Pickering site is fully developed, and therefore the environmental changes due to addition of extra lines will be minimal.

9.0 ALTERNATIVES CONSIDERED

9.1 ALTERNATIVE FUELS

Initially, the Pickering site was designated as a potential eight-unit nuclear station site. The existing Pickering G.S.-A will share many common services with the proposed station such as service building facilities, vacuum building vapour suppression capabilities and trained operating personnel, resulting in economic savings. Table 9.1 gives the total capacity of the system as of April 1973 and the various methods of generation on a percentage basis.

9.1.1 Coal

The use of coal as an energy supply for a 2000 MWe station is feasible in Ontario. At present, coal is used to produce 40.3% (6,094 MWe) of the total energy capacity in the Ontario Hydro System (Tables 9.1 and 9.2). In 1972, Ontario Hydro burned 8.4 million tons of coal. The use of coal would require docking facilities at Pickering to allow large lake freighters to bring in coal from US suppliers in West Virginia and Pennsylvania. Coal would also require that the proposed station be equipped with all the pollution control equipment necessary to meet local, provincial and federal air pollution regulations. Ash disposal and an extensive coal pile area would pose additional problems. The conclusion is that nuclear fuel represents a significant advantage at this site over coal.

9.1.2 Fuel Oil

One Lake Ontario generating station (Lennox G.S.) is committed to firing with oil and another Lake Ontario oil-fired generating station (Wesleyville G.S.) is waiting for Government approval. The competition for low-sulphur fuel oil is intense due to the conversion of many industrial and domestic heating plants to the use of this fuel in compliance with local air pollution regulations. Large oil storage tank farms would be required at the Pickering site. The selection of oil is considered unattractive as a fuel for this site, mainly because of the projected low reliability of supply in addition to the present committment.

TABLE 9.1

SYSTEM CAPACITY

April 1973 Total Capacity = 15,067,200 kw.

Method of Generation	Percentage of Total
Hydraulic	41.6
Thermal (Coal – 40.3) (Gas – 2.1)	42.4
Nuclear	11.8
Combustion Turbine	2.6
Purchase	1.6
	100.0

9.1.3 Combustion Turbines

Combustion turbines are used by Ontario Hydro as a source for emergency power and for peaking power. Present combustion turbines account for 2.6% of the peak dependable total capacity (Table 9.1). Their small size and high cost are not suited for base load service and thus are not considered as a practical alternative.

9.2 ALTERNATIVE ONCE-THROUGH COOLING METHODS

9.2.1 Tempering

Tempering is used to decrease the temperature of the effluent in order to meet criteria for upper temperature limits or temperature rise through the condensers. Tempering requires increased pumping capacity to mix ambient lake water with the condenser discharge, entrains more organisms and modifies flows. Tempering would result in lower temperatures near the discharge, but the total lake surface area used for heat dissipation would increase, due to the larger discharge volume and slower rate of heat loss to the atmosphere.

An untempered surface discharge as designed results in a higher discharge temperature in a smaller volume of water. However, with either a tunnelled or surface intake the upper temperature criterion (90°F) would not likely be exceeded with the present design during the summer months because maximum summer temperatures at the location of the offshore intake are below 70°F and the temperature rise across the condensers will be 20F° or lower.

For the proposed station, with present knowledge, surface water tempering does not appear to be an alternative which would effect a lower overall environmental impact at this site.

9.2.2 Alternate Discharge Velocities

The proposed low velocity surface discharge places warm water on the surface so that increased rates of cooling to the atmosphere are achieved in the near-shore area. Increasing the velocity of the surface discharge will tend to reduce the surface area of heated water due to increased vertical and horizontal entrainment of the discharge with the surrounding lake water. Higher temperatures would therefore occur at near-shore depths which may tend to influence the benthic community both by direct heat and scouring action. At a site such as Pickering where the offshore depths do not increase rapidly, recirculation may be a problem.

9.2.3 Submerged Discharge

Offshore discharge using a submerged pipe would result in lower temperatures in littoral zones. Such a discharge would have to be raised off the lake bottom to avoid disturbance of sediments. Discharge temperatures would be rapidly reduced by entrainment with the surrounding water body and the loss of heat would take place at a slower rate in areas away from the shoreline.

Disruption of any existing thermocline and the resulting biological effects would be an environmental disadvantage of such a discharge. Also, recirculation of cooling water may be a problem if the intake is also located offshore.

9.2.4 Common Surface Discharge

Figure 21 is a prediction of the extent of a surface discharge to the SW using the present discharge channel for all eight units. The increased momentum would approximately double the surface area enclosed by an isotherm 2F° higher than ambient. Increased flow would

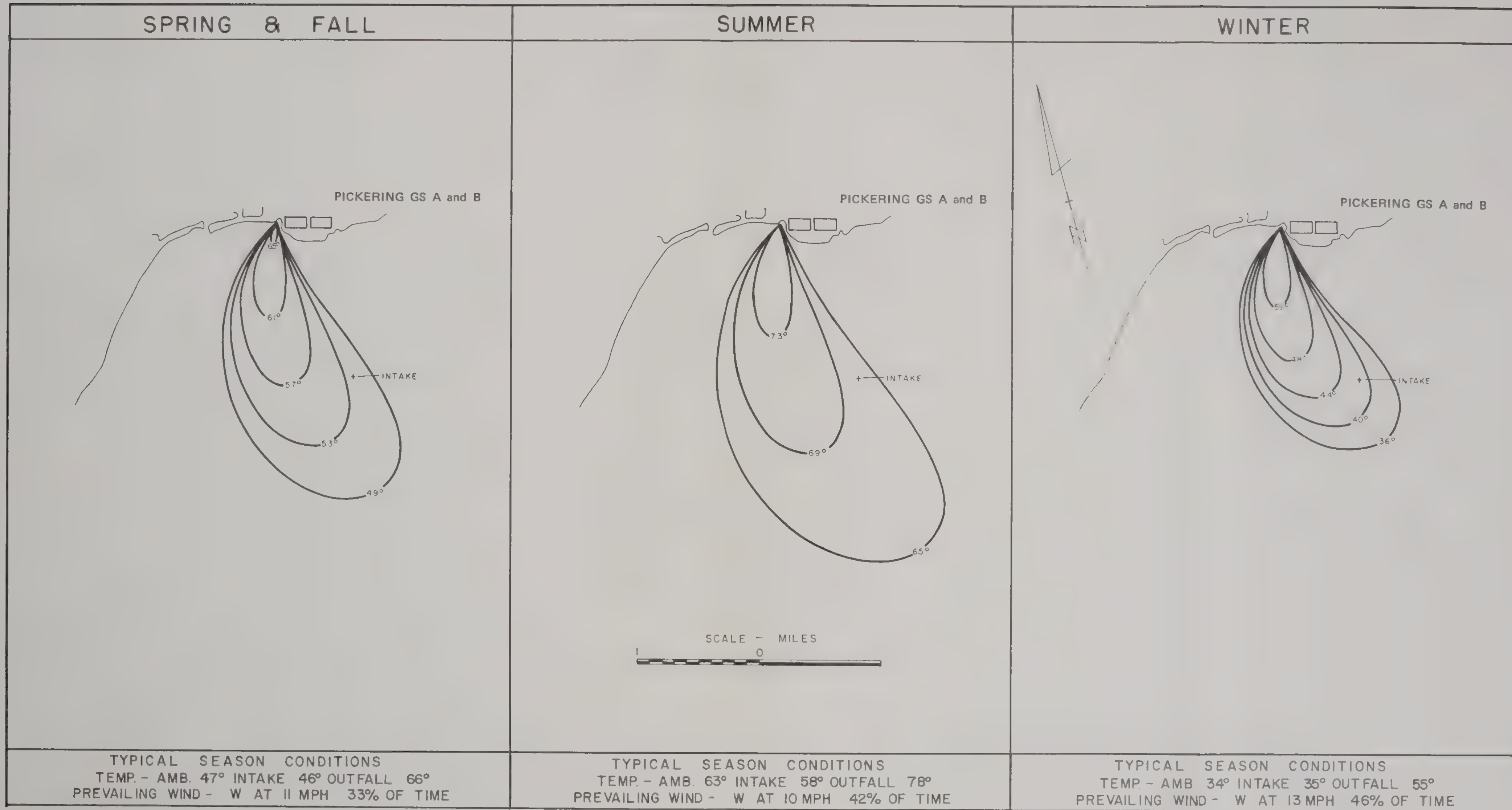


FIGURE 21 LAKE SURFACE THERMAL PLUME PREDICTION 8 UNIT PLANT, WEST OUTFALL – TUNNEL INTAKE

result in more scouring and disruption of benthic communities in the immediate outfall area. Shoreline disruption to the west near the entrance of Frenchman Bay by the plume, under southerly to easterly winds could increase the probability of erosion and silting of the shoreline. Under adverse wind conditions there would be a greater probability of thermally influencing Frenchman Bay.

TABLE 9.2

FUEL USED AT OPERATING THERMAL GENERATING STATIONS AND STATION CHARACTERISTICS

	Location	No. of Units	Designed Capacity (At Full Load)	Fuel Used
R.L. Hearn G.S.	Toronto on Lake Ontario	8 (4) (4) 3 Comb Turb*	1,200,000 kW (100,000 kW/Unit) (200,000 kW/Unit) 22,500 kW (7,500 kW/Unit)	Coal & Natural Gas Oil
Lakeview G.S.	Mississauga on Lake Ontario	8 3 Comb Turb	2,400,000 kW (300,000 kW/Unit) 19,500 kW (6,500 kW/Unit)	Coal Oil
Nanticoke G.S.	Nanticoke on Lake Erie	8 3 Comb Turb	4,000,000 kW (500,000 kW/Unit) 22,500 kW (7,500 kW/Unit)	Coal Oil
J.C. Keith G.S.	Windsor on Detroit River	4 1 Comb Turb	264,000 kW (66,000 kW/Unit) 5,000 kW	Coal & Lignite Oil
Lambton G.S.	Courtright on St. Clair River	4 3 Comb Turb	2,000,000 kW (500,000 kW/Unit) 22,500 kW (7,500 kW/Unit)	Coal Oil
Thunder Bay G.S.	Thunder Bay on Lake Superior & Mission River	1 2 Comb Turb	100,000 kW 24,000 (12,000 kW/Unit)	Coal & Lignite Oil
Pickering G.S.- A	Pickering on Lake Ontario	4 3 Comb Turb	2,160,000 kW (540,000 kW/Unit) 22,500 kW (7,500 kW/Unit)	Natural Uranium Oil
Douglas Point G.S.	Kincardine on Lake Huron	1	220,000 kW	Natural Uranium

* Combustion Turbine

9.2.5 Shoreline Intake

The shoreline intake for Pickering G.S.-A has resulted in silting of the condenser cooling water system. Recirculation of the buoyant surface discharge into the surface intake has been recorded. Deflecting booms or groins extending out from the intake may help alleviate silting and recirculation problems (Section 8).

Other disadvantages of a shoreline intake include increased intake of plankton, ice, weeds, and debris. One advantage would be that any stratification of the offshore area would not be disturbed to the same degree if the discharge point was also located at the surface. Fish intake could be reduced by a shoreline screening system, but the existing information does not indicate that this possible advantage outweighs the numerous and obvious disadvantages. A shoreline intake, therefore, does not appear to offer an overall environmental advantage over an offshore intake.

9.3 ALTERNATIVE FORMS OF TRANSPORT OF NUCLEAR REACTOR WASTES TO THE BURIAL SITE

It is present Ontario Hydro policy to ship all radioactive wastes to the Bruce Nuclear Power Development site by Ontario Hydro truck carrier.

A rail spur line is planned into the proposed new service maintenance centre to be situated due north of the proposed station. Studies are under way to determine the feasibility of transport by rail of wastes from the Pickering site to the Bruce Nuclear Power Development site based on procedural, economic and safety considerations.

Though regulations do exist (112) which set procedures for transport of radioactive materials by air (International Air Transport Association, Department of Transport, Individual Carriers and Ontario Hydro Regualtions), it is not considered economic to transport large, heavily shielded containers of waste by air. Some transport by road would still be required.

10.0 GLOSSARY OF TERMS

This glossary lists and defines a number of frequently used terms not normally found in a dictionary, or used in a context which differs from the normal:

Absorbed dose	- when ionizing radiation passes through matter, some of its energy is imparted to the matter. The amount absorbed per unit mass of irradiated material is called absorbed dose, and is measured in 'rads'.
Acclimation temperature	- the temperature at which an organism, after a period of constant exposure, achieves a stable response when exposed to stress.
Biochemical oxygen demand (BOD)	- the quantity of oxygen consumed by microorganisms to stabilize the organic matter in a body of water.
Black start	- start-up of main generating units one at a time with initial power supplied solely by self-starting standby sources of power installed at the station.
Bloom	- a high density growth, usually of algae, imparting a turbidity or colour to water.
Blowdown	- the intermittent discharge of boiler water to reduce the concentration of impurities which remain in the boiler during the evaporation of feedwater.
Cladophora	- a branched, filamentous green alga which has special hold-fast organs. It grows in enriched waters, attached to rocks or other suitable substrates in shallow lake locations.
Derived release limits (DRL's)	- estimates of the maximum permissible average release rates if compliances with the maximum permissible dose for members of the public is to be ensured.
Decibel (dB)	- the standard measure of noise or sound pressure level, expressed as a logarithmic ratio of the sound pressure of a given noise with respect to a reference sound pressure which is commonly taken as 0.0002 microbars in the context of sound and human hearing. For many types of noise sources found in urban or industrial areas, a frequency weighting scale designated as "A" gives good correlation between measured noise levels and judged human annoyance. Readings using this scale are reported as A-levels in decibels, abbreviated dBA.
Epilimnion	- the uniformly warmer and turbulent superficial layer of a lake when it is thermally stratified during summer. The layer above the thermocline.
Final preferendum	- the point at which the selected temperature is equal to the acclimation temperature.

Fumigation	- the downward dispersion of emissions associated with a marked difference in stability between air above a stack plume and a relatively unstable layer below the plume. Condition develops from the ground upward as the rising sun heats the ground, resulting in higher than normal ground level condentrations.
Heavy water (D_20, deuterium oxide)	- water containing significantly more than the natural proportion (1 in 6500) of heavy hydrogen (deuterium) atoms to ordinary hydrogen atoms. Heavy water is used as a moderator and heat transport fluid in the PHW Candu reactor because it slows down neutrons effectively and also has a low cross section for absorption of neutrons.
Hypolimnion	- the uniformly cold and deep layer of a lake when it is thermally stratified during summer. The layer below the thermocline.
Lapse rate	- the rate of change of temperature with height above the ground.
Man-Rem	- the number of men times the averaged whole body dose absorbed by each man.
Plume (thermal)	- the area of a body of water which is influenced by the thermal discharge, temperature being measurably higher than ambient conditions.
Rem(Roentgen equiv. man)	- the unit of dose equivalent of any ionizing radiation which produces the same biological effect as a unit of absorbed dose of ordinary X-rays.
Selected temperature	- the temperature most frequently chosen by organisms in a temperature gradient.
Stability	- the tendency of the atmosphere to resist or increase vertical motion as defined by temperature lapse rate and wind shear.
Tempering	- the process whereby condenser discharge water is mixed with lake water to reduce its temperature before returning to the lake.
Thermal stratification	- the layering of bodies of water having different heat contents.
Thermocline	- a layer of water in which temperature differences exceed 1C° for each metre of depth.

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REPORT ON

PUBLIC PARTICIPATION PROGRAM

AND

REVIEW WITH THE VARIOUS GOVERNMENT MINISTRIES

CONTENTS

1.0 INITIATION OF PROGRAM

1.1 The public participation program started with the issue of our Proposal and Environmental Assessment for Pickering G.S. "B" which was sent to the Provincial Minister of Energy and to the following Provincial Ministries on November 9 and 13, 1973, respectively, for comment:

Ministry of the Environment
Ministry of Natural Resources
Ministry of Agriculture and Food
Ministry of Health
Ministry of Transportation and Communication
Ministry of Treasury, Economics and Intergovernmental Affairs

1.2 Also at this time, copies of Ontario Hydro's Proposal and Environmental Assessment were sent to the Atomic Energy Control Board (November 14, 1973) for their information.

2.0 PUBLIC PARTICIPATION

2.1 In parallel with our discussions with the Provincial Government, Ontario Hydro started work on a public participation program. Briefly, our program consisted of:

a) Meeting with local elected official and local press. This meeting was by invitation, and the following attended:

Fred Wade
Metro Toronto Conservation Authority

Bill McLean
Metro Toronto Conservation Authority

Ken Higgs
Metro Toronto Conservation Authority

Jack Anderson
Pickering Township Council

Don Kitchen
Pickering Township Council

George Ashe
Mayor-Elect, Pickering Township

Ric Rathburn
CHOO Radio, Ajax

Ian Sutton
CKLB Radio, Oshawa

Bob Watson
Pickering Post

Lloyd Robertson
Oshawa Times

Bill Newman
Ontario MPP

Dave Bass
Pickering Township

Prior to this meeting, all those invited received a copy of our Proposal and Environmental Assessment. This meeting was held on November 27, 1973 at the Pickering G.S. Information Centre. At this meeting, Ontario Hydro made a brief introduction and then opened the meeting to questions. Attached hereto, is a list of the questions asked. We believe none of the questions can be construed as opposition to the project. Also attached are press reports on this meeting.

2.2 A public meeting was held on December 11, 1973 at the Pickering G.S. Information Centre, attended by approximately 130 people. To ensure that the public in Pickering and vicinity had the opportunity to attend public participation meetings on the expansion to Pickering G.S., the following action was taken:

(i) Newspapers - News Releases were made available to all appropriate newspapers in the area. (a sample is attached). A Notice of Public Meeting advertisement was run as listed below. (A sample is attached).

Weekly

Oshawa	- This Week	- November 28, December 5
Ajax	- News Advertiser	- November 28, December 5
Pickering	- Pickering & Bay News	- November 28, December 5
Pickering	- Pickering Post	- November 29, December 6
Ajax	- Ajax Guardian	- November 29, December 6

Daily

Oshawa	- Oshawa Times	- November 28, December 5, 8 & 10

(ii) Radio - Station CKLB, Oshawa - 30 second commercials

5 December to 9 December - twice daily	-	10 commercials
10 December to 9 December - 4 times daily	-	8 commercials
		18 total

Station CHO, Ajax - 30 second commercials

5 December to 9 December - twice daily	-	10 commercials
10 December & 11 December - 5 times daily	-	10 commercials
		20 total

(Samples of the above are attached).

In addition to the above, statements were given on newscasts over local and Toronto radio stations. Some Toronto TV stations played taped interviews with Mr. Bill Morison, Assistant Director of Generation Project Division, Ontario Hydro, a few days prior to the public meeting, when an invitation was made to anyone interested in attending the public meeting on the Pickering Station. Taped interviews were played over local radio stations following the meeting with elected officials.

(iii) Local distribution of Environmental Assessment synopsis -

- 1,000 copies of the synopsis were delivered door to door by the Canada Post Office in the Bay Ridges and Squires Beach communities.

- Copies of the synopsis were made available to all who attended the public meeting on December 11.

- A supply of the synopsis was made available to each location at which the Full Environmental Assessment and Proposal were located for public perusal (as listed on the synopsis cover).

Proposal & Environmental Assessment -
Copies were located as follows:

7 copies - Township Office for Pickering
4 copies - Township Offices and public libraries
in Ajax and Whitby
1 copy - Ajax Hydro-Electric Commission Office
1 copy - Whitby Public Utilities Commission Office
2 copies - Regional Office of the Municipality of Durham
2 copies - Office of Pickering Post and Pickering
Bay News
2 copies - Offices of the News Advertiser and
The Ajax Guardian
1 copy - Offices of the Oshawa Times
1 copy - Radio Station CHOO in Ajax
21 copies TOTAL

(iv) Return Mailing Response Cards -

These were available at the public meeting with attention drawn to them by the meeting Chairman. The response has been minimal.

(v) Survey - A random survey of 25 households was conducted in the area adjacent to the generation station (a copy of which is attached). This took place four weeks prior to the public meeting. The general feeling conveyed to the interviewer was a lack of concern about our plans to double the capacity of the station. The main reason for this is felt to be the continuing community relations program performed at the Information Centre at the plant which is visited by more than 100,000 visitors each year. Over recent months, the information on the proposal to expand the capacity of Pickering G.S. has been made known to all those who visit the Information Centre.

(vi) A copy of the Proposal and Environmental Assessment was sent to several organized interest groups; e.g. Pollution Probe, Sierra Club, Federation of Ontario Naturalists. Only Pollution Probe acknowledged a written receipt of this document and offered comments.

As with the meeting with the elected officials, most of the questions raised were of the interest type with no apparent organized opposition to the proposed project. For your information, attached hereto is a copy of the various press reports on this meeting, and questions asked. Ontario Hydro did receive a direct letter from Pollution Probe, a copy of which is attached hereto.

After informal consultation with various Township Officials and Ontario Hydro's assessment of the results of our public meetings, it was decided a second public meeting was not required.

3.0 REVIEW WITH MINISTRIES

3.1 With regard to the discussions with the Provincial Ministries, the status is as follows:

Ministry of Health	-	Letter dated December 27, 1973, received indicating they are satisfied with Ontario Hydro plans for the proposed project (copy attached to this report).
Ministry of Treasury, Economics and Intergovernmental Affairs	-	Letter dated December 18, 1973 received indicating they are satisfied with Ontario Hydro plans for the proposed project (copy attached to this report).
Ministry of Transportation and Communications	-	Letter dated December 4, 1973 received indicating they are satisfied with Ontario Hydro plans for the proposed project (copy attached to this report).
Ministry of Agriculture and Food	-	Letter dated January 15, 1974 received indicating they are satisfied with Ontario Hydro plans for the proposed project (copy attached to this report).
Ministry of the Environment	-	Letter received from this Ministry on February 7, 1974 with the comments on Ontario Hydro's proposal and Environmental Assessment. Meeting held to discuss these comments on February 22, 1974 and Ontario Hydro's reply to the Ministry of the Environment on March 1, 1974, confirming agreement reached (copy of the above-mentioned letters is attached to this report).

Ministry of Natural Resources	-	Letter received from the Ministry of Natural Resources on January 23, 1974 with comments on Ontario Hydro's proposal and Environmental Assessment. Ontario Hydro's reply to these comments and a letter to the Ministry of Natural Resources dated March 1, 1974 (a copy of the above-mentioned letters is attached to this report).

4.0 CONCLUSIONS

4.1 Public Meetings

There was no apparent opposition to the proposed expansion of the Pickering Generating Station at either the meeting with the elected officials or the public meeting. With the exception of some public concerns about noise during construction of the proposed plant, most other questions were of the "interest" type. With regard to the noise questions, they can be generally categorized under three main headings as follows:

(i) Traffic noise

(ii) Public address system noise

(iii) Pile driving noise

Ontario Hydro plans to widen Brock Road to four lanes, develop an improved site public address system and to use pile driving equipment only during the day shift. This appears to have satisfied the concerns. Ontario Hydro will continue to work with the Durham Region and the Pickering Township with a view to arriving at a mutually acceptable final plan on these matters.

4.2 Concerns from the Various Ministries

The following four Ministries have no concerns regarding the proposed project and have duly confirmed this in writing, to Ontario Hydro:

Ministry of Health

Ministry of Treasury, Economics
and Intergovernmental Affairs

Ministry of Transportation and
Communications

Ministry of Agriculture and Food

Comments have been received from both the Ministry of the Environment and the Ministry of Natural Resources and each comment has been replied to by Ontario Hydro, copies of which are attached.

In general, both ministries have reservations or concerns related to the open circuit cooling system using Lake Ontario water. Concern exists regarding the intake and damage to fish, and the biological effects of the discharge of warm water on the local lake bottom ecology.

The environmental effect of open circuit cooling using the waters of the Great Lakes and interconnecting rivers has been under detailed investigation at each Ontario Hydro thermal station, including Pickering A, for some time. In one of the investigations (Nanticoke), a joint investigation program, involving both the Ministry of Natural Resources and the Ministry of Environment, has been underway for several years. The investigation at each of the stations is discussed with and agreed to by the Ministry of Environment and all data and information is made available to the Ministry of Environment and Natural Resources. To date, only minor effects have been detected in the littorial biota and in some slight shifts in the seasonal occurrences and number of invertebrate fauna.

More recently, the Ministry of Environment, Ministry of Natural Resources, Ontario Hydro, and representatives of Environment Canada, formed a Task Group to study the effects of cooling water discharges on the aquatic environment. In addition, Ontario Hydro initiated a detailed study involving laboratory thermal models, controlled field measurement and analytical studies, to investigate and develop improved cooling systems for future stations, to minimize the effects of open circuit cooling systems on the ecology of the lakes.

It is Ontario Hydro's belief that the effects of the Pickering extension on the ecology of the lake will be insignificant. However, Ontario Hydro accepts the condition that if significant adverse environmental effects due to the open circuit cooling system are subsequently discovered, remedial measures will be taken to eliminate or minimize these effects.

On the basis of the various communications between Ontario Hydro and these two Ministries with regard to the conceptual plans for the expansion of the Pickering Generating Station, together with Ontario Hydro's commitments to keep them fully informed on matters of mutual interest as plans develop, we believe their concerns have been satisfactorily answered.

5.0 MEETING WITH ELECTED OFFICIALS - ATTACHMENT

PICKERING G.S. "B" QUESTIONS ASKED AT MEETING WITH ELECTED OFFICIALS AND MEDIA NOVEMBER 27, 1973

Officials Present at Meeting

Fred Wade
Metro Toronto Conservation Authority

Bill McLean
Metro Toronto Conservation Authority

Ken Higgs
Metro Toronto Conservation Authority

Jack Anderson
Pickering Township Council

Don Kitchen
Pickering Township Council

George Ashe
Mayor-Elect, Pickering Township

Ric Rathburn
CHOO Radio, Ajax

Ian Sutton
CKLB Radio, Oshawa

Bob Watson
Pickering Post

Lloyd Robertson
Oshawa Times

Bill Newman
Ontario MPP

Dave Bass
Pickering Township

1. Is Hydro placing a deadline beyond which time they will no longer accept comments or suggestions with respect to their proposal to duplicate the Pickering plant?

   If so, why?

2. What do you hope to gain from these public comments?

3. Comment - The pile driving noise must be eliminated.
   The P.A. System noise must be eliminated.
   Brock Road must be widened to four lanes.

4. How will the public be made aware that these public meetings will take place?

5. Comment - Newspapers and radio are not sufficient.
   A mass mailing with the appropriate information should be carried out.

6. Please explain your plans with respect to the proposed intake tunnel.

7. Will this plan cut down on the 10,000 pounds of fish caught on the screens each day?

8. Will the plans for Pickering "B" be made available in details to the MTRCA?

9. Will the MTRCA be able to work with Hydro on the overall landscaping plans?

10. Does Hydro have any future plans for the fifteen acre recreation park on the east side of Sandy Beach Road now being leased to Pickering Township?

11. Comment - Perhaps some of the excavated fill from either the new plant or the Maintenance Centre could be used for a ski hill in this recreation park.

12. Comment - The only plan Hydro has for that area is the possibility of the Nuclear Training Centre being moved to the northwest corner of Montgomery Park Road and Sandy Beach Road. This would not affect the park.

13. Why would Hydro consider moving the Nuclear Training Centre from its present location?

14. Would you please clarify that the actual limit is with respect to radiation emissions to the atmosphere and how this might affect the people in the immediate vincinity of the plant?

15. Would you please explain the purpose of the combustion turbines at the Pickering Station?

16. How often are these combustion turbines operated?

17. What do you do with the dead fish you collect?

18. Has the MTRCA ever heard of the Duffins Creek Conservation Authority?

19. What plan does Hydro have for the Township pumping station?

20. Considering the construction and operation phases of the new plant, how much more noise can be expected over and above what we have put up with in the past with the present station? I am referring now not only to steam noise, but to construction noise as well.

21. How soon do you expect nuclear generation to surpass conventional generation?

22. Is there any plan to change the present design of Canadian Nuclear Power Stations?

23. Does the CANDU design utilize uranium more efficiently than any other type of design?

24. Is the supply of uranium in Canada unlimited?

25. Does the proposal by Denison Mines to sell Canadian uranium to Japan bother you?

26. Does the present heavy water situation bother you?

27. Will other heavy water plants have to be constructed in order to operate Pickering "B"?

28. Is Pickering "B" the final stage of development for the Pickering site?

29. Will Hydro require any more land for any reason at the Pickering site?

30. How do you plan to get the power from Pickering "B" out into the grid?

31. Would you care to comment on the recent Solant Commission hearings?

32. What will the future bring with respect to nuclear power?

33. What other methods of producing electricity are being looked into?

34. Comment - This type of meeting is a big change from the original one held for Pickering "A" back in 1962. I think Hydro should be commended for the effort.

35. Is Hydro aware that the Pickering Township Council has formally requested James Auld, Minister of the Environment, to involve Ontario Hydro in public participation meetings with respect to Pickering "B", and stated that the Township would like to be involved in them as well?

36. Comment - This has been an excellent meeting and a credit to Ontario Hydro.

37. Comment - Motion seconded - this has been a worthwhile meeting, however, I must depart because of a prior commitment.

Nuclear plant plans unveiled

By LLOYD ROBERTSON
Times Staff Writer

PICKERING (Staff) — Plans for doubling the capacity and size of the Pickering nuclear generating station were unveiled Tuesday night to an invited audience of less than two dozen.

It was the first of a series of meetings, the remainder to involve the public, to explain Hydro's plan to add four generators to the four which have been in operation for nearly three years.

The addition will go on the east end of the present plant and will not require further land purchases since the original concept for the plant was for eight generators.

The project is expected to cost $1.149 billion and its construction will employ, at its peak, about 3,350 men, said Hydro officials.

If all approvals are received, work will begin next fall and the first 540 megawatt unit will be producing power by 1980. The next two will be in service in 1981 and the project will be completed in 1982.

When completed, the station will be capable of producing 4,320,000 kilowatts and the station will employ 525 people. There are 325 working at the plant now.

No further land will be needed for transmission lines to the major transformer station at Cherrywood, four miles north of the plant. The right-of-way is capable of carrying two more tower lines.

The new plant will share the facilities of the present two-storey service wing and the present administration building will require no addition.

Present Tuesday night were some members of Pickering Township council, Ontario South MPP William Newman, Fred Wade, chairman of the Metro Toronto Conservation Authority and some of his staff and some of the Pickering Township staff.

THE OSHAWA TIMES

Wednesday, November 28, 1973

Ashe warns Hydro

Doubling station could cause flack

By LLOYD ROBERTSON
Times Staff Writer

PICKERING — Hydro officials can expect some flack hen they take their plan to ouble the size of the Pickering uclear generating station to e public, says mayor-elect ee Ashe.

A meeting last night in hich the plans for the $1.15 llion project were shown to ickering Township councillors, the Metro Toronto and egion Conservation Authority nd other area officials, Mr. she said Hydro could expect bjections from those who are raditionally opposed to any hange but also from those who ppose expansion of the plant n legitimate grounds and oncerns.

He said he had no personal bjections but would like to see ome changes made in the contruction job this time around.

"There would have to be a onstruction schedule geared o neighbors don't have to put p with a pile driver running for 4 hours per day," he said.

"... Hydro should find a much better system of outside communications," he suggested. "We can hear the messages better in Bay Ridges than workmen can hear them on site."

He also told the gathering, which was predominantly Hydro, that the utility would be asked to build a four-lane extension of Brock Rd. from Bayly St. south to the plant site. Brock Rd. is now under construction and a cloverleaf is being built at Hwy. 401. The road from there to Bayly St. will be four-lane.

FOUR LANES

John McCredie, of Hydro, chairman of the group of 26 who met on site, agreed that there should be a four-lane street to Montgomery Park Rd. He added that Hydro would this time ask the contractor to work within the township's noise bylaw which, he said, appeared to ban such noise between 8 p.m. and 8 a.m.

"I think Hydro was given an exemption to the bylaw when they built the first station," said Coun. Don Kitchen.

He added that a planned spur line from the CNR main line would be used to bring some of the material to the site this time.

The meeting was told that a portion of Hydro land north of Montgomery Park will be set aside in the event that Hydro's nuclear training centre in Rolphton is brought to this area.

Coun. Jack Anderson wondered if the noise problem associated with the start of the present plant had been solved.

MUFFLE NOISE

He was told that mufflers had been installed in some noise areas, except the steam release valves where mufflers are forbidden.

But, one engineer noted, there had been only one complaint of the steam release since last winter.

"Since then we have the system tuned out," he explained, "and the valves don't release as often as they did when the plant was starting."

Hydro plans to involve the public in at least two meetings in coming weeks, said Arthur Hill, of the generation concept department. One will be held on Dec. 11 and, he said, the second is tentatively scheduled for Jan. 15. If more are necessary, they will be arranged.

"If the public wants to criticize," he said, "we'll con-

THE OSHAWA TIMES

November 28, 1973

Size of nuclear plant to be doubled

By Cy Elsey
Staff Reporter

ns for doubling the size of the nuclear ing station at Pickering — at an estimated t of $1.15-billion — were unveiled before about 35 ic leaders last night.

Politicians were told the estimated cost is based the value of 1982 dollars, leading one Ajax icial to comment "it just boggles the mind."

Ontario Hydro proposals call for construction to rt next year — or as soon as the views of the ulatory authorities and the response from the blic permit.

It is expected that the first 540-megawatt unit l be brought into service in 1980. Two similar ts will be added in 1981, and the fourth the next ar.

The Pickering site was originally acquired for eight-unit installation and the new units will lize existing engineering and construction ertise.

Pickering Township Mayor - elect George Ashe e NEWS ADVERTISER the giant project will a higher grant -in-lieu of taxes paid to the municipality, and he visualizes the amount reaching $2-million by 1980.

The project is expected to serve as an economic stimulus to the area, and it is estimated that construction manpower requirements will peak at approximately 3,350 men.

On maturity, the operating staff for the twin stations will total 525. At present, Pickering's operating personnel totals 325.

"Obviously this project will be a big benefit to ratepayers in the area," said Ashe. "I'm hoping, of course, the two million dollar grant will be primarily for the benefit of the new town of Pickering."

He said he is not too concerned about any possible danger from the expansion program because "virtually it doesn't exist."

Ashe indicated that Ontario Hydro will have to pay the shot for widening Brock Road to four lanes between Bayly Street and the nuclear plant.

Construction of a cloverleaf on Highway 401 at Brock Road may start next year, he said.

Ashe also says that council will likely insist that construction noises, from such equipment as piledrivers, be kept at a minimum so as not to disturb people living in the Bay Ridges area.

He maintains the plant's out-door loud-speaker system can be heard in Bay Ridges , and this must be stopped or at least curtailed.

Public meetings will be held to inform people of the proposed expansion plans for the nuclear station, and the first has been scheduled for Dec. 11 starting at 8 p.m. at the station's Information Centre.

"The purpose of this meeting is to explain and receive comments on the proposal to double the capacity of the nuclear station on the existing site," said a Hydro spokesman.

Hydro chairman George Gathercole says that doubling the size of the plant means the total capacity of the site would be 4,320,000 kilowatts.

"The proposal," he said, "reflects Hydro's belief in the Canadian nuclear reactor as an effective means of meeting the province's electric power requirements . . . in these days of threatening energy shortages it is of critical importance that we push ahead with our nuclear program as rapidly as possible."

The Atomic Energy Control Board is examining Hydro's application for approval to proceed with the expansion program.

The AECB is the licensing authority for all nuclear stations in Canada.

The Pickering proposal reflects Hydro's continuing confidence in CANDU nuclear generation. While the capital cost of nuclear power stations is higher than for fossil-fueled stations, operating costs are lower and fuel supplies — uranium oxide — are more reliable.

In addition, nuclear generation appears more acceptable to the public from the environmental standpoint.

A Hydro spokesman says it is expected that nuclear generation will ultimately comprise the major share of Hydro's electrical generating capacity.

To be located in line with the east end of the existing plant, the proposed addition will be connected to and will share the facilities of the present two-storey service wing.

The present Administration Building will provide office and administration facilities, telephone and public-address equipment rooms, and a cafeteria for both stations.

By locating the new station at Pickering rather than at an alternative site, Hydro can take advantage of existing design expertise, and manpower requirements will be reduced.

The first of the four existing Pickering reactors has been in successful operation now for almost three years, and this past experience will help engineers and designers to introduce substantial improvements in areas of high costs and concern.

The environmental assessment indicates that the station can be located on the Pickering site without significant harm to the environment.

Duplication of an existing station will allow early evaluation of environmental concerns and will ensure minimal environmental effects.

6.0 PUBLIC MEETING - ATTACHMENT

The documents contained in this section are true copies of the originals.

PICKERING G.S. "B" QUESTIONS ASKED AT PUBLIC MEETING DECEMBER 11, 1973

1. What about the noises at night and in the daytime?
2. What are oil fired generators?
3. Construction noise control; e.g. piledriving?
4. How about the loud public address system?
5. What about plant access road arrangements?
6. Railway level crossing?
7. Waste management transportation plans?
8. Increases in radioactivity?
9. Measurements of citizens re: radiation absorption?
10. Load forecasting - certainties.
11. Plant "boundaries" define - what account of height?
12. Hydro policy re: promotion of electrical usage.
13. First station expansion?
14. Life expectancy of present plant?
15. Life expectancy of present plant?
16. Guaranteed long term uranium supply?
17. Considerations re: Pickering Airport?
18. Visualization of transmission corridors?
19. Effect of coolant discharge on drinking water?
20. What happens after end of plant life?

21. Accident contingency plan - basis, and type of accidents considered? Liklihood of such?

22. Hydro's uranium supply vs other demands....(other Province's export).

23. Effects of accident on public.

24. Have we had any accidents?

25. Are CANDU stations sensitive economically to uranium prices?

26. Desirability of fuel supply to CANDU reactors.

27. Attempts to develop fission product/plutonium use (in reactors).

28. Application to production of hydrocarbon fuels...

HYDRO NEWS RELEASE

November 27, 1973

ONTARIO HYDRO PROPOSES EXPANSION OF NUCLEAR PLANT AT PICKERING

Ontario Hydro will hold public meetings to outline plans for an addition to its nuclear generating station at Pickering.

Hydro Chairman George Gathercole said that meetings with the public and elected officials concerning the proposed duplicate station would be held while the Atomic Energy Control Board is examining Hydro's application for approval to proceed. The first of these public meetings is scheduled for December 11 at the Information Centre on the Pickering site.

The new station would be a nominal repeat of the existing station with four generating units, each with a capacity of 540,000 kilowatts. The proposed station would be completed in 1982 and mean that the total capacity of the site would be 4,320,000 kilowatts.

"The proposal", said Mr. Gathercole, "reflects Hydro's belief in the Canadian nuclear reactor as an effective means of meeting the Province's electric power requirements. In these days of threatening shortages it is of critical importance that we push ahead with our nuclear program as rapidly as possible".

November 30, 1973

Mr. Jim Cane
Advertising Manager
Radio Station CKLB
Oshawa, Ontario

Dear Mr. Cane:

We desire to place a series of 30-second commercials with your radio station on the following dates, taking advantage of the saturation rate.

The commercial will run on the following dates: twice daily from Wednesday, December 5 to Sunday, December 9, inclusive (10 commercials); then four times each day on Monday, December 10 and Tuesday, December 11 (8 commercials). The commercial should be changed to read "tonight" on Tuesday, December 11.

Attached is the desired copy for the 30-second radio advertisement.

The account for the above 30-second radio advertisement should be sent to Mr. D.W. Pettigrew, Broadcast Media Supervisor, Ontario Hydro, 620 University Avenue, Toronto.

Thank you for your help in this matter.

Yours truly,

C.G.W. MacIntosh
Public Relations Officer
Central Region

CGWMacI:mr

cc D.W. Pettigrew
D.A. Patriquin

Ontario Hydro invites the public to attend a meeting to discuss the proposal to double the capacity of Pickering Nuclear Generating Station.

The meeting will be held at the Information Centre at Pickering Generating Station on Tuesday evening, December 11, at 8:00 p.m.

We desire open planning with public participation.

Ontario Hydro will make available all details related to the proposed power plant expansion.

Your comments are solicited and will form part of the final proposal for the power station expansion.

November 30, 1973

Mr. W.I. Skinner
Advertising Manager
Radio Station CHOO
AJAX, Ontario

Dear Mr. Skinner:

We desire to place a series of 30-second commercials with your radio station on the following dates, taking advantage of the saturation rate.

The commercial, will run on the following dates: twice daily from Wednesday, December 5 to Sunday, December 9, inclusive (10 commercials); then five each day on December 10 and 11 (10 commercials). The commercial should be changed to read "tonight" on Tuesday, December 11.

Attached is the desired copy for the 30-second radio advertisement.

The account for the above 30-second radio advertisement should be sent to Mr. D.W. Pettigrew, Broadcast Media Supervisor, Ontario Hydro, 620 University Avenue, Toronto.

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We desire open planning with public participation.

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Your comments are solicited and will form part of the final proposal for the power station expansion.

MR. M.E. BRADDEN
Manager - Community Relations

November 28, 1973

H-1248

500 T - Pickering

Community Relations around
Pickering Generating Station

As you requested, Central Region Public Relations Department has given assistance with this work, especially to coincide with the announcement of the twinning of Pickering GS.

Following two meetings in Central Region Office some ten days ago with R. Phelps and then with Ivan Lloyd and R. Phelps, an attitude study at the grass roots level was carried out on two occasions last week by Alan Fulton, Assistant Public Relations Officer, in Bay Ridges community adjacent to Pickering GS.

The findings as a result of the questions asked by Al Fulton during his visits to homes in that area were very interesting and confirmed that no great concern was felt by the residents regarding the doubling of the size of the nearby nuclear power plant.

Attached is the excellent report by Mr. Fulton which enabled us to reach some of the silent majority who usually do not attend meetings.

C.G.W. MacIntosh
Public Relations Officer
Central Region

CGWMacI:mr

enc

cc F.J. Dobson
J. McCredie

FILE November 21, 1973

RANDOM SURVEY OF RESIDENTS
NEAR PICKERING GENERATING STATION

It was agreed at our last meeting, November 14, that a small survey of residents in the immediate area of Pickering Generating Station might be of some value when planning future community relations programs.

On November 19 a survey was initiated and 25 local residents, chosen at random, were interviewed. 75% of the respondents were housewives and 80% had children under the age of 12.

A map is attached showing the two areas and the streets where the survey was conducted.

The persons interviewed were asked to respond to the following equestions:

1. Are you aware that Ontario Hydro is planning to double the size of Pickering GS?

2. How long have you resided in the area?

3. Have you any concerns, or have you had any problems regarding the station? (a) during the main construction period? (b) since the plant began operating?

4. Have you visited the Information Centre or taken a tour of the station?

Responses to the questions are as follows:

1. 76% were aware that we were doubling the size of the station. 2. 50% had resided in the area five years or longer. 75% had resided in the area three years or longer.

3. 16% mentioned radiation hazards at some time during the interview.

   (a) 48% had been annoyed by the public address system. 16% were concerned about the traffic and 8% complained about other construction noise during the main construction period.

   (b) 44% complained about the steam noise and 8% mentioned the public address system since the plant began operating. (The last 2 or 3 years).

4. 72% had visited the Information Centre or toured the station. All respondents with children said the children had visited the Centre on school days and many times on weekends.

In general, the impression I received was that the residents have become accustomed to the station being there and they really do not mind it.

A few people thought the generating station had encouraged other industrial development in the area and they hoped that this would result in reduced residential taxes. A few people mentioned the new park but wondered when it would be open to the public.

It is also interesting to note that although only 16% actually mentioned radiation, one respondent said, "If it blows up it blows up" and another person wanted to know if doubling the station would also double the possible radiation hazards.

JAF:mr

J.A. Fulton
Assistant Public Relations Officer
Central Region

cc C.G.W. MacIntosh
Ivan Lloyd
Ray Phelps

Pollution Probe Scarborough,
c/o J.S. Woodsworth Public School
120 Sedgewick Drive,
Scarborough, Ontario,
December 10, 1973

Mr. W.G. Morison,
Assistant Director,
Generation Projects Division,
Ontario Hydro,
610 University Avenue,
Toronto, Ontario,
M5G 1X6.

Sir:

As a resident of Scarborough (Guildwood Village) and an environmentalist, I would like to take this opportunity to commend the staff of Ontario Hydro for the excellent report - "Ontario Hydro's Second Nuclear Generating Station at Pickering". I must note that this environmental assessment study, if it is an indication of Provincial action in this new policy area (Throne Speech, 1972), is worthy of public admiration for its attempt at thoroughness; informed comment, and useful qualities of brevity and comprehension for the layman.

I was pleased to receive advance notification of the procedure involved in getting necessary approvals for this needed facility. I feel that information contained in the study will give ratepayers and other interests in the area sufficient facts with which to deal at any future environmental hearing board meetings. Certainly I would recommend to the Ministry of Energy that he speak to his colleague, the Minister of the Environment, to endeavour to obtain copies of this excellent study for sample distribution to agencies preparing assessment studies under new guidelines to be issued in the new year.

Although these views happen to be my own - I am quite sure that most reasonable groups in Scarborough support your new procedure of providing the fullest disclosure of facts. This is in marked contrast to certain American jurisdictions which have had constant flights over this material. Too often, Canadian environmentalists adopt the rhetoric of American eco-groups toward the nuclear field. They fail to take note of the

superiority of our CANDU-reactor system and the world of difference in jurisdictions involved. For once and all I would hope that people would recognize our Canadian environmental engineering planners for the good work they pioneer.

Wishing your report every critical success in the days ahead.

Environmentally yours,

LWS:mp

L.W. Steele,
Administrator/Trustee,
Pollution Probe Scarborough
and Director,
Community Consultants
Environmental Action
(Ontario) Ltd.

Hydro explains plans for expansion

Plans are being prepared by Ontario Hydro to widen Brock Road to four lanes south of Bayly Street and to construct a rail spur line, in conjunction with proposals to double the size of the nuclear generating station at Pickering.

The two projects were announced at a public meeting held to inform people of the nuclear plant expansion program.

Entrance to the plant will also be made easier for motorists with the construction of a cloverleaf on Highway 401 at Brock Road and work on this project may start next year.

About 130 people attended the information meeting, including representatives of Pickering Township, Pollution Probe, the Durham Region Planning Board, the Ontario Ministry of Health, and the Atomic Energy Control Board, which is the federal licensing authority for all nuclear stations in Canada.

Hydro Public Relations Officer Pat Kelley told the NEWS ADVERTISER that if it is decided another simliar meeting should be held at the station's information centre, it may take place Jan. 15.

The project is expected to serve as an economic stimulus to this area, and it is estimated that construction manpower requirements will peak at approximately 3,350 men.

"We felt the meeting went extremely well, and it appeared most of the people who went there left feeling fairly good about the whole idea," said Kelley.

Questions at the meeting evolved mainly around noise that may be created by construction machinery, the possibility of radiation leaks, and the energy crisis.

Hydro officials outlined plans to reduce the noise factor and explained the intricate safety precautions built into the plan to eliminate the possibility of leaks.

The meeting was told it is Hydro's intention to construct an expansion to the plant which meets all safety requirements and regulations, and to undertake in-service inspections throughout the life of the station to ensure the station remains in a safe and reliable condition.

Hydro officials were asked what would happen if an aircraft, landing or taking off from the Pickering international airport (if built), crashed into nuclear station.

"We feel that it is improbable that such an accident will ever occur," said an official, who also pointed out that the nuclear station is about eight miles from the proposed airport.

Besides, he said, a missile such as an aircraft engine would have to be travelling at least 500 mph to pierce the concrete domes of the reactors.

"This is an improbable speed for an aircraft in a landing pattern," he said.

Even if that happened, he said, and the reactor were ruptured, only 500 units of contamination would reach the most exposed person at the plant's boundary.

AJAX NEWS ADVERTISER

December 19, 1973

Canadians can take a bow

It's not often that Canadians can genuinely give themselves a pat on the back.

Perhaps it's part of our national character or something, but most Canadians seem to have a visceral feeling that domestic achievements must be second-rate. In many cases, we are only too ready to accept foreign accomplishments — British, French, American, or whatever — as superior to our own.

That's why the recent decision of Ontario Hydro to go ahead with four more reactors at the Pickering Nuclear Station gladdened our hearts. In this field of technology, Canada is ahead of every other country in the world — with the possible exception of the USSR.

The Americans, often regarded as superior technological beings, are pitifully far behind in the field of nuclear power. Hamstrung by red tape and ignorance, the scientific genius which constructed the gaseous-diffusion plant at Oak Ridge has proven unable to repeat the triumph in peacetime.

On the other hand, there are definite indications that the Russians are as far advanced over us as we are over the Americans. Fission plants are now being built inside major cities, and there is some evidence that the Russian physicists are close to setting up a practical fusion reactor.

Still, we can be justly proud of the Canadian effort in connection with the CANDU reactor. In these days of universal energy shortages, CANDU represents a lifeline.

We trust that the accomplishment will not be marred by short-sightedness in a related field: the production of heavy water. We now purchase a certain amount of our heavy water abroad — and recent events in the oil-supply situation have demonstrated the dangers of such a policy.

It is to be hoped that the governments will press ahead with plans for additional heavy-water plants in Canada.

There will, no doubt, be objections to the Pickering expansion, and some protests may be well-founded. We hope, though, that we won't hear any more ill-informed verbiage about the dangers a nuclear plant presents.

Those who designed and built the CANDU reactors are neither ignorant nor malicious, and there is a wide safety margin. The chances of a pile going critical are so small as to be negligible. If you wait to be killed by a chain-reaction in a CANDU reactor, you'll be dead of old age first.

You've got a far better chance of being killed, crippled and so on every time you ride in a car.

The nuclear plants are something of which Canada can be justifiably proud. Criticism is welcome; but let it, at least, be informed criticism.

NEWS ADVERTISER

December 5, 1973

Nuclear plants

No Hydro station has had radiation leak — crowd told

PICKERING (Staff) — There never has been a radiation "leak" at a Hydro nuclear-powered generating station and even a major accident would not release radiation at danger levels to those outside the plant, a group of about 120 was assured Tuesday night as Hydro showed the public its plans for doubling the size of the Pickering generating station.

Hydro plans to build four more reactors immediately east of the four already in operation there and Hydro officials, along with officials from Atomic Energy of Canada, were on hand to answer any questions.

Most of the 28 questions centred around the possibility of radiation leaks.

Donald Watson, a Hydro engineer, explained that there is a natural background of radiation everywhere and measurements at the Pickering plant are about one-half the counts at Bancroft from natural causes.

"You can't say no radioactive material escapes," he said, "but at the plant boundary you can't measure it."

One questioner wondered what would happen if an aircraft headed for or leaving the proposed Pickering international airport should crash into the generating station.

"We feel that it is improbable that such an accident will ever occur," said one Hydro official, noting that the station is eight miles from the proposed runways.

Besides, he said, a missile, such as an aircraft engine, would have to be travelling at at least 500 mph to pierce the concrete domes of the reactors, an improbable speed, he said, for an aircraft in a landing pattern.

Even if that occurred and the reactor were ruptured, he continued, only 500 units of contamination would reach the most exposed person at the plant's boundary. He said that it requires 25,000 units to lower the white blood cell count.

FALLOUT

Mr. Watson said radiation contamination would more likely consist of fallout on pasture fields nearby. Cows would eat that grass and radiation would be spread through the milk. In such an event, he said, health officials would have ample time to prevent such a spread to humans.

Gordon Brooks, general manager of Atomic Energy of Canada, said he was a "victim" of the last such "accident", which, he said, occurred at Chalk River in an experimental plant in 1952. He and others there were contaminated when the plant "ran wild."

William Morison, of Hydro, chairman of the meeting, said that no such accident has ever hit a generating station.

CANDU plants, such as the one at Pickering, use two and one-half times less fuel than United States nuclear generating stations, Mr. Brooks said, and it now appears that plants will be constructed in Argentina and Korea.

Dr. Donald Hurst, chairman of the Atomic Energy Control Board, said there are known reserves of 240,000 tons of "low cost uranium" in Canada but, he added, "we'll have to be assured there is a reserve for the committed generating stations and more."

THE OSHAWA TIMES

December 12, 1973

7.0 COMMENTS FROM PROVINCIAL MINISTRIES - ATTACHMENT

The documents contained in this section are true copies of the originals.

MINISTRY OF HEALTH
COMMUNITY HEALTH STANDARDS
DIVISION

P.O. Box 425, Station "Q"
Toronto, Ontario.
M4T 2M5

December 27, 1973.

Mr. J. McCredie (F17)
Project Study Coordinator,
Pickering G.S. Units 5-8,
Generation Projects Division,
Ontario Hydro,
620 University Avenue,
Toronto 2, Ontario.

Re: Pickering "B"

Dear Mr. McCredie:

You may be aware that my colleagues and I had expressed some surprise that, in an earlier version of your document "Proposed Generating Station for Pickering" which we received through the Atomic Energy Control Board, no mention was made of alternative which might avoid the need for siting another large nuclear station so close to the population of Toronto. Your new version of the document rectifies this and places on record the careful consideration (which, of course, we knew had been given) lying behind the choice of the Pickering site.

In the light of this new document, and from the airing of our concerns by our Minister in a letter to Mr. Gathercole dated July 27, 1973, and at a meeting on October 4, 1973, we are satisfied that due consideration has been given to the health and safety of the public.

Though a number of technical questions regarding Pickering "B" will arise from time to time, there are none of such fundamental importance as need to be raised at the moment.

Yours sincerely,

J.H. Aitken,
Senior Consultant,
Health Physics

MINISTRY OF TREASURY
ECONOMICS AND
INTERGOVERNMENTAL
AFFAIRS

December 18, 1973.

Mr. J. McCredie,
Project Study Co-ordinator,
Pickering Generation Study,
Generation Projects Division,
Ontario Hydro,
620 University Avenue,
Toronto, Ontario.

Dear Mr. McCredie:

Re: Proposed Generating Station
at Pickering

I received a copy of your letter of November 13 to Mr. H.I. Macdonald and the attached document, "Proposed Generating Station for Pickering".

My staff has had an opportunity to review the report and it would seem that there is no conflict between the proposals put forward in it and the goals for the Central Ontario Region. Inasmuch as the report addresses itself to the expansion of the existing Pickering Generating Station, no new or significant variables seem to be in evidence that would affect our goals for the area east of Metro.

My thanks for being provided with the opportunity to examine this issue.

Yours sincerely,

C. Peter Honey,
Assistant Deputy Minister
Urban and Regional Affairs

cc Messrs. H.I. MacDonald
D.J. Gordon

MINISTRY OF
TRANSPORTATION
AND
COMMUNICATIONS

Planning Division,
1201 Wilson Avenue,
Downsview, Ontario,
M3M 1J8

December 4, 1973.

Mr. G.E. Gathercole,
Hydro Electric Power Commission
of Ontario,
620 University Avenue,
Toronto 2, Ontario.

Re: Proposed Generating Station for Pickering, (units 5-8)

Dear Mr. Gathercole:

The Minister has asked me to reply on his behalf with regard to Ontario Hydro's document, "Proposed Generating Station for Pickering" that was distributed to several Ministries on November 9th, 1973.

It would appear that this Ministry's Construction Program would be compatible with any requirements anticipated for this expansion of your Pickering site. Particularly, the interchange at the Macdonald Cartier Freeway and Brock Road is now under construction as is the interim widening of the Macdonald Cartier Freeway to 6 lanes. Further to this, the ultimate plan envisaged for Highway 401 in this area is a collector-distributor type facility, but it is anticipated that construction of this will not be undertaken for some time.

Considering the transit system in this area, the Bay Ridges Dial-A-Bus system was utilized by this Ministry originally as a demonstration project. It has since been turned over to the Township of Pickering (as of January 1973). However, the GO Railway facility is still under the jurisdiction of the Ministry of Transportation and Communications. It is not anticipated that the planning or operation of this will be adversely affected by the expansion of the Pickering Generating Station.

In conclusion, the proposed extension to the existing facility at Pickering does not appear to be detrimental to any current plans of this Ministry.

Yours sincerely,

G.H. Johnston,
Executive Director.

Copy to: Messrs. D.A. Evans
D.J. Fleming
L. Danis
J.D. Muncaster
R.N. Sequin
D.J. Gordon
W.E. Raney
H.A. Smith
H.J. Sissons
D.B. Ireland
O.S. Russell
R.H. Hillery
P.G. Campbell
W.G. Morison
A. Hill
M. Nastich

MINISTRY OF
AGRICULTURE
AND FOOD

January 15, 1974

Mr. W.G. Morison,
Assistant Director of
Generation Projects,
Ontario Hydro,
620 University Avenue,
TORONTO 2, Ontario.

Dear Mr. Morison:

RE: PROPOSED GENERATING STATION FOR PICKERING

This document has been reviewed in our Ministry and we would comment as follows:

The establishment and expansion of the proposed generating station at Pickering, as outlined in the Report of the Ontario Hydro, dated October, 1974, will have no adverse affect on commercial farm development in that area. The site is on the north shore of Lake Ontario at Moore Point, in the Township of Pickering, about 20 miles east of the city. The land in that area has already been zoned and/or being used for commercial, industrial or residential development.

In fact, it is in agriculture's interest that expansion of new generating stations be confined to sites that are already established for this purpose, as opposed to selecting new sites in areas where angriculture could be adversely affected.

Yours very truly,

K.E. Lantz,
Assistant Deputy Minister.

MINISTRY OF THE ENVIRONMENT

February 7, 1974.

Mr. J. McCredie,
Project Co-ordination,
Generation Concepts,
Ontario Hydro,
77 Bloor Street West,
Toronto, Ontario.

Dear Mr. McCredie,

Re Proposed Nuclear Generation Station for Pickering "B", Review of Environmental Assessment Report

We have reviewed your Environmental Assessment for the above noted project and conclude that certain additional background data and analysis is required of Ontario Hydro before we can give the Ministry's official response to the proposal. You will note that the deficiencies in the Assessment are similar in nature to those we identified on the proposed Wesleyville G.S.

We consider the information requested is essential for a proper evaluation of the environmental implications of this Hydro expansion. Undoubtedly, you and your staff will want to discuss some of these matters with our technical staff. I would be pleased to arrange a meeting with our appropriate staff.

As usual, should you require any clarification of the points discussed, please do not hesitate to contact me.

Yours very truly,

V.W. Rudik,
Acting Director,
Strategic Planning Branch.

INFORMATION REQUIRED FROM ONTARIO HYDRO IN REGARD TO THE PICKERING UNITS 5 TO 8 PROPOSAL

A. OPERATIONS

1. Records of intake and discharge temperatures for the complete operational period of the present Pickering generating station.

2. Records of daily peak load and daily power generated for the present station.

3. Detailed information on the occurrence of recirculation of cooling water including dates, times, duration and degree of recirculation (i.e. temperature rise above lake ambient).

4. Detailed data on the daily impingement and removal of fish (species and amounts) removed by the screening system during the present station's operational life.

5. Details of times, durations and levels of chlorination for each condensor half of each unit since the start-up of that unit.

6. Details of times, amounts and levels of radioactive wastes released to the aquatic environment for the present Pickering station.

B. HYDRAULIC

1. Complete records from studies undertaken on temperatures and currents in the area.

2. Data on all thermal plume measurements undertaken at the Pickering station.

3. Results of studies on the effect on recirculation and other problems (i.e. turbidity) of (i) the hanging curtain and (ii) the intake groins.

4. Physical model study results on recirculation of units 1 to 4 and on the effects of the proposed extension thermal discharge.

5. Results of theoretical plume modelling using a range of operating and climatic conditions.

6. A detailed assessment of the longshore extent of present and projected thermal plumes.

C. BIOLOGICAL

1. Data on all 1973 biological and water quality studies conducted in the area either for or by Ontario Hydro.

   The above to include:

   a) Data on the species of fish and their relative numbers in samplings from thermally affected and unaffected areas.

   b) Growth rates of fish found in the thermal plume and unheated areas

c) Data on the amounts and kinds of food being utilized by fish in the area of the thermal discharge and in unheated areas

d) Locations of spawning areas used by fish common to the area of the thermal discharge

e) Data on benthic invertebrate population in and remote from the thermal plume and projected thermal plume

f) Data on the effects of the thermal discharge on the standing crops of attached algae in the area.

D. WASTE HANDLING

1. Identification of the disposal site for non-radioactive wastes.

2. Identification of nuclear waste disposal site(s) to accommodate off-site disposal, including a clear statement of the capacity in relation to the significantly lengthy operation of the plant.

3. Details on the supervision required for shipment of radioactive wastes from the site to the disposal area.

E. EMERGENCY PRECAUTIONS

In the event that the pressure relief system does not activate or that the vacuum building is unservicable, it is our understanding that the reactor stacks could present a major release point for radioactive articles. This and other matters related to radioactive releases should be outlined in a contingency plan forming part of the Assessment.

F. CONVENTIONAL WASTES

1. The design of the new station, and its transformer facilities in particular, should ensure that there will be no oil loss from the oil containment and handling systems. Detailed reference is required in the Environmental Assessment.

2. The feasibility of alternative condenser cleaning systems should be examined, and compared with the use of chlorine for environmental suitability, in the Assessment report.

G. GENERAL COMMENTS

The Environmental Assessment should clearly outline:

(1) the cummulative potential effects of the present and proposed facilities on the immediate site owned by Hydro and on the surrounding area and community; and

(2) the inter-relationship amongst

a) Ontario Hydro's present and proposed facility

b) The present and/or enlarged municipal water filtration plants at Brock Road and in Ajax; and

c) the proposed York-Pickering sewage treatment plant when at ultimate capacity

including identification of problems, alternative solutions, and a recommended course of action.

(3) Any conceptual thinking on possible future expansion of generation capacity at the Pickering site and its cumulative effect on the area environment.

March 1, 1974

J. McCredie

File: NK30-0000P

The Ministry of the Environment,
135 St.Clair Avenue West,
Suite 100,
TORONTO, Ontario.
M4V 1P5.

Attention: Mr. V.W. Rudik
Acting Director
Strategic Planning Branch

Dear Sir:

Proposed Nuclear Station for Pickering
Review of Environmental Assessment

This is further to our submission to Mr. E. Biggs on November 13, 1973 of our Proposal for the Pickering Generating Station, your letter dated February 7, 1974 and our meeting in Ontario Hydro offices on February 22, 1974, all on the above-mentioned subject.

The main purpose of our recent meeting was to review the additional background information requested by your Ministry and to reach agreement on when such information would be made available by Ontario Hydro. On the basis of a continuing exchange of information between the Ministry of the Environment and Ontario Hydro on matters of mutual concern, we are hopeful, because of our extremely tight program aimed at obtaining government approval towards the end of March 1974, you will find it possible to give approval of the Pickering "B" project within the next two weeks, conditional on Ontario Hydro continuing to keep the Ministry of the Environment fully informed on matters of mutual interest.

With regard to the additional information requested, the following program was agreed to:

a) OPERATIONS

1. Request — Records of intake and discharge temperatures for the complete operational

		period of the present Pickering Generating Station.
	Action	Although recent changes have been made to the intake arrangements on Pickering "A" (addition of groins), the available information will be forwarded to the Ministry of the Environment in approximately 2 weeks.
2.	Request	Records on daily peak load and daily power generated for the present station.
	Action	Our Mr. G. Turcott will be contacting your Mr. A.F. Johnson with a view to arranging a visit to the Pickering Generating Station to review load data which is readily available.
3.	Request	Detailed information on the occurrence of recirculation and cooling water, including dates, times, durations and degree of recirculation (i.e. temperature rise above lake ambient).
	Action	This information will be sent to the Ministry of the Environment in approximately 6 weeks.
4.	Request	Detailed data on the daily impingement and removal of fish (species and amounts) removed by the screening system during the present station's operational life.
	Action	Ontario Hydro's daily record will be sent to the Ministry of the Environment in approximately two weeks.
5.	Request	Details of times, durations and levels of chlorination for each condenser half of each unit since the start-up of that unit.

Action The chlorination system is not yet fully commissioned and hence has been used very sparingly. we suggest this matter can be discussed further when Mr. Johnson visits the Pickering Generating Station.

5. No further action is required on this item on the basis that this information is covered in documentation sent, or to be sent, to the AECB; i.e. Site Evaluation Report and Safety Report.

b) HYDRAULIC

The information requested under items 1, 2 and 3, will be forwarded to the Ministry of the Environment as follows:

REPORTS COMPLETED AND SUBMITTED TO MINISTRY OF THE ENVIRONMENT

Aquatic Weed Growth - 1968
Pickering, Wesleyville and Lennox

Ice Conditions - 1969
Lennox, Pickering and Wesleyville

Aquatic Weed Growth - 1969
Pickering, Wesleyville, Lennox and Winona

Offshore Water Temperatures - 1970-71
Pickering

Nearshore Currents - Pickering - 1971

Thermal Plume - Pickering - 1971-72

REPORTS COMPLETED AND WILL BE FORWARDED TO MINISTRY OF THE ENVIRONMENT WITHIN ONE WEEK

Summary of Nearshore Currents - 1972
Pickering, Bowmanville, Wesleyville and Chub Point

Water Temperatures - Pickering - 1972

Effect of Deflection Boom on Recirculation of Cooling Water Effluent - 1973

Level Fluctuations and Channel Currents at Frenchman Bay - 1973

REPORTS TO BE COMPLETED

Water Temperatures - 1973 (Completion - April 30, 1974)

Nearshore Currents - 1973 (Completion - May 31, 1974)

Suspended Sediment Measurement - 1973 (Completion - March 15, 1974)

Thermal Plumes - 1973 (Completion - April 1, 1974)

It was agreed that item 4 can best be resolved during a visit to our Hydraulic Model which will be arranged in the next few weeks.

With regard to items 5 and 6, it was agreed that the actual plume information covered by item 2 above, will meet this requirement.

c) BIOLOGICAL

All the information covered by this section will be sent to the Ministry of the Environment in approximately 3 weeks.

d) WASTE HANDLING
AND
e) EMERGENCY PRECAUTIONS

It was agreed that no further action is required on these items on the basis that this information is covered in

documentation sent, or to be sent, to the AECB; i.e. Site Evaluation Report and Safety Report.

f) CONVENTIONAL WASTES

1. We confirm that a design is being developed which will prevent pollution as a result of oil loss from transformers. We will discuss this matter further with you when more information is available.

2. Item a) 5 above we believe covers this item.

g) GENERAL COMMENTS

With regard to items 1, 2 and 3, we offer the following general comments for your consideration:

1. The report on the York-Pickering Sewage Treatment Plant was not available until after our Environmental Assessment went to printing. However, we have had preliminary discussions with the consultant (Proctor & Redfern Ltd.) who prepared this report, and with your Mr. G.A. Pearce. Also, we arranged to have a member of our staff attend the public hearings on this project which were held at the Pickering G.S. Information Centre. From our discussions with the consultant and Ministry of the Environment staff, we are not aware of any problems regarding the interface between Pickering "B" and the sewage treatment plant.

2. We have discussed the water supply to the municipal filtration plant at Brock Road with the Pickering Township and Durham Region and have tentatively agreed to provide a water supply from our intake if the Pickering "B" discharge has any detrimental affect on the present municipal filtration plant intake.

3. We have no conceptual plans for any future extension beyond Pickering "B" on the Pickering site.

We trust you will find this information adequately records the agreement reached.

Yours truly,

J. McCredie
Project Co-ordinator
Pickering GS "B"
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JMcC;jk

cc: Messrs. H.A. Jackson
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MINISTRY OF
NATURAL SOURCES

Policy Research Branch
Whitney Block
Queen's Park
Toronto, Ontario

January 23, 1974

Mr. W.G. Morrison
Assistant Director of
Generation Projects
Ontario Hydro
620 University Avenue
Toronto, Ontario

Re Proposed Generating Station
For Pickering - your memo of
Nov. 13/74
- your file NK30-0000P

As requested please find herewith five copies of the Ministry of Natural Resources response dated January 22, 1974 to your proposal as above. We have been in contact with your Mr. J. McCredie.

Unless you need more input from us, and contact us in respect of our response, please consider this as the official response of this Ministry.

Q.F. HESS/r

J.W. Giles
Assistant Deputy Minister
Lands and Waters
Ministry of Natural Resources

Attachments

ONTARIO MINISTRY OF NATURAL RESOURCES

Analysis and Comments Respecting

Ontario Hydro's October 1973

Environmental Assessment

of the

Proposed Generating Station for Pickering

Policy Research Branch Environment Quality Co-Ordination January 22, 1974 File: 50.1.8.5
(Hess)

NoteThis analysis is based on input from the
following:- Policy Research Branch
Sport Fisheries Branch
Wildlife Branch
Forest Management Branch
South Central Region
Maple District
Lands Administration Branch

ONTARIO MINISTRY OF NATURAL RESOURCES

Analysis and Comments Respecting

Ontario Hydro's October 1973

Environmental Assessment

of the

Proposed Generating Station for Pickering

1. Background from the Ontario Hydro Report

The Pickering site at present accommodates a nuclear generating station consisting of four units designated Units 1 to 4. The proposed additional generating station will consist of four units designated Units 5 to 8 (page 1, Ontario Hydro Proposal).

It is proposed that (page 2):

- generation be committed for first in-service of 1980.
- this generation be provided by a 2160MW nuclear station comprising four 540 MW units.
- construction would start in 1974. One unit would come into service in 1980, two in 1981 and one in 1982.
- the station design to be similar to that of the existing nuclear station on the Pickering site. The estimated capital cost of the proposed station is $1,149,000,000 in 1982 dollars.

Ontario Hydro's environmental assessment for Pickering indicates the station can be located on this site without significant harm to the environment (page 9).

2. Ontario Ministry of Natural Resources Environmental and Other Concerns in respect of the Proposed Pickering Generating Station

These include the following:-

- forests and plants
- fish and wildlife
- rivers (as defined in The Lakes and Rivers Improvement Act, R.S.O.)
- recreation
- land above and under water and dredging, dumping, filling

The Ministry of Natural Resources reiterates its position that Ontario Hydro must give adequate consideration to the total future cumulative environmental impact on Lake Ontario in respect, particularly, of the cumulative effects of waste heat discharge. The impact of waste heat discharge on-shore disposal from a series of generating stations along the shore of Lake Ontario (Lennox, Wesleyville, Bowmanville, Pickering) is not known. The Ministry of Natural Resources predicts that a very large percentage of the "littoral" zone will be placed under stress and that the entire lake ecosystems will be damaged. This will frustrate our plans to rehabilitate the lake.

3. Analysis of Ontario Hydro's Environmental Assessment for the Proposed Generating Station for Pickering - Exerpts from the Ontario Hydro Report followed by the Comments of the Ministry of Natural Resources

3.1. Forests and Plants

(a) Ontario Hydro's Report says that non-radioactive emissions to air from on-site sources will result in only minor effects on the existing air quality (page 8). Existing conventional air quality is good due to the absence of any large emissions from industry in the area. Gas turbines now on the site are used infrequently for peak power requirements and emergency internal uses. During operation of the proposed station the conventional air quality will be influenced by infrequent use of further gas turbine capacity. Ground level concentrations of sulphur dioxide will still be well below regulatory requirements (page 3). Wind data indicates that station emissions will be dispersed over land areas approximately two-thirds of the year (page 3).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

The forests occurring within a twenty mile range of the Pickering G.S. include several hundred acres under agreement with the Ministry of Natural Resources under The Woodlands Improvement Act and several hundred acres under The Forestry Act.

SO2 standards and design criteria imposed by the Ministry of the Environment are acceptable as long as the Ministry of Natural Resources can be confident that the operation of the G.S. will be such as to meet

those standards at all times during its lifetime.

(b) Ontario Hydro's Report says that radioactive emissions from the existing station have been measured since 1971. There has been no detectable increase in background radiation dose rate levels due to the operation of the first three units of the existing Pickering G.S. An increase in the level of tritium in air has been measured but the calculated resultant dose to the public is negligible. The proposed station will be designed to operate within design targets of 1% of the Derived Release Limits for conformance with regulations on radioactive emissions. Area monitoring would continue to measure any changes to the natural background radiation levels due to operation of the existing and proposed stations (page 3).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

The radioactive emissions standards and design criteria imposed by regulation are acceptable as long as the Ministry of Natural Resources can be confident that the design and operation of the G.S. will be such as to meet those design targets at all times during its lifetime. The values of interest to the Ministry in this respect include the plants, fish, wildlife and the ecosystems within the zone of influence of the Pickering G.S.

It is noted that data on prevailing ground level winds, climatology, and stability classes are documented for the general area, but specific site data on atmospheric conditions such as vertical temperature lapse rates, nocturnal and seasonal inversions, lake breeze effect, and mixing layer depths are lacking (page 60).

3.2. Wildlife

Ontario Hydro's Report says that the original tree cover in the site areas has been long since removed and the land converted to agricultural use. Only a few trees, mainly sugar maple, elm and beech, are left to mark the lot boundaries and ownership. The area is now considered good crop land with good to moderately good drainage. The soil is fertile and produces high yields of corn, grain and hay. Vegetation cover found along the shore and in the areas of Ajax Marsh or Pickering Beach was detailed in a report by the Ministry of Natural Resources (69).

Planted trees and remnant hardwoods and conifers interspersed with vacant grass lots are found in the residential area. Typical trees of this marsh area are white spruce (*Picea glauca*), black willow (*Salix nigra*), weeping willow (*Salix babylonica*), cottonwood (*Populus dettoides*), American elm (*Ulmus americana*), tulip tree (*Liriodendron tulipifera*), and sugar maple (*Acer saccharum*).

Typical of the main marsh is the common cattail (*Typha latifolia*), with sedges (*Cyper- aceae*), grasses (*Graminae*), and rushes (*Juncus*), forming a semicircle around the main marsh on the east side. The larger pools at times are covered with duckweed (*Lemna*) and pond lilies (*Nymphaea*).

Hardwoods, in two stands of ash or ash/elm, are isolated in a small patch near the marsh, and the other along Carruther's Creek, the only stream watering the whole area. Many hardwoods, especially maple, elm, poplar and willow are widely found in the two larger woodland tracts.

Typical softwoods are eastern hemlock (*Tsuga canadensis*), white cedar (*Thuja occidentalis*), black willow (*Salix nigra*), glaucous willow (*Salix discolor*), quaking aspen (*Populus tremuloides*), beech (*Fagus grandifolia*), white oak (*Quercus alba*), American elm (*Ulmus americana*), Hawthorn (*Crataeque spp.*), choke cherry (*Prunus virginiana*), pin cherry (*Prunus pennsylvanica*), sugar maple (*Acer saccharum*), black maple (*Acer nigrum*), white oak (*Fraxinus americana*), redosier dogwood (*Cornus statonifera*), common elder (*Sambucus canadensis*), and alder (*Alnus sp.*) (page 92, 93).

Ducks are the most important wildlife resource along this section of the Lake Ontario shore and inhabit the various marshes in the area such as Second Marsh - Oshawa, Darlington Park, Cranberry Marsh and the mouth of such rivers as Duffin Creek and the Rouge River (69).

Frenchman Bay area supports a variety of migratory waterfowl (21). During the spring and fall considerable numbers of mallard (*Anas platyrhynochos*), black ducks (*Anas rubipres*) and Canada geese (*Branta canadensis*) were noted on the lake. A few individuals of these species also frequented the bay. In the late fall, migrating whistling swans (*Cygnus columbianus*) have been seen along the shoreline. During the winter, the open lake forms the resting ground for large numbers of old squaw ducks (*Clangula hyemalis*).

During the summer, there is a small resident breeding population of black and mallard ducks in Frenchman Bay (page 93).

The proposed ultimate development of the Frenchman Bay area envisages:

(i) The Bayshore including the sand spits for use by water-oriented recreational facilities, with the west shore for use by local residents.

(ii) Commercial marinas and public boat launching facilities confined to the eastern shore of the bay.

(iii) Retention of the marsh area at the head of the bay.

Incorporated in the long-range planning of the east bayshore is use of Ontario Hydro land fronting onto Liverpool Road as a parking area serving the east spit, the Ontario Hydro park as well as the local marinas. Also included is the reclamation of some 15 acres of marshy area between Browning Street and the North East Creek for ultimate expansion of marina facilities.

Along the western side of Duffin Creek, land is being acquired by the Duffin Creek Conservation Authority for retention as a wildlife area (Fig. 14). The proposed Duffin Creek Park is potentially one of the most valuable open spaces in the eastern sector of the waterfront, rich in wildlife with one of the most productive wetlands in the region. The park proposal is primarily development of a passive use, naturalistic area, with picnicing on the west side and in conjunction with a swimming area in Rotary Park on the Ajax side. The Duffin Creek area could be divided into three zones:

Zone 1	Open grass lands
Zone 11	Treed ravine slopes
Zone 111	Marsh land

The Duffin Creek Park proposal envisages development of 550 acres at an estimated cost of \$900,000, with the main entrance off Montgomery Park Road (page 103).

No marsh areas exist on the proposed site. Wildlife distrubed will be birds occupying the few remaining trees on site as well as mammals such as skunks, muskrats, mink, groundhogs, squirrels, mice, moles and shrews which are common to the area (17) (page 117).

Some wildlife disturbed during construction is expected to return to less populated areas of the new station site (page 143).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

It is the policy of the Ministry of Natural Resources to preserve wetlands in southern Ontario. Very few good quality wetlands remain along the Lake Ontario shore.

In the vicinity of the Pickering G.S. there are four marshes which interest us as they have good capability ratings - the one at the mouth of Duffin Creek immediately to the east of the G.S. (1), the small one on the creek mouth immediately to the west of the G.S. (2) and the ones associated with Frenchman Bay (the northern (3) and western (4) corners of the Bay). Frenchman Bay itself is important for waterfowl.

Following is a listing of the capability and suitability of these five areas for waterfowl production and hunting:

		Capability production,hunting	Suitability production, hunting
(1)		3,4	4,5
(2)		3,3	3,3
(3)		3,3	3,3
(4)	(probable - not rated separately because of size)	3,3	3,3
(5)	(Frenchman Bay)	6,4	6,4

The capability limitations of these areas are as follows:

	Production	Hunting
(1)	deep water, soil and water fertility	potential short-term water level fluctuations, deep water, size
(2)	potential short-term water level fluctuations, soil and water	potential short-term water level fluctuations, soil & water fertility
(3)	"	"
(4)	probable "	"
(5)	deep water	deep water

A Class 3 capability designations means

Slight limitations affect duck production. Water is moderately fertile and the supply is permanent or intermittent. The nesting fringe is capable of producing fair to good grasses and legumes. Surrounding land is capable of producing fair to good small grains within 5 miles or good small grains within 5-10 miles. Existing wetlands in the same land unit and watershed grow a good variety of submergent and emergent vegetation. Slight limitations associated with water supply, quality and/or land factors affect class 3 wetlands. OR...Class 4 wetlands which can be drained and fallowed. OR... Class 1 or 2 wetlands with 2 or 1 level of limitation, respectively, due to water depth.

Photocopies of the capability and suitability maps are appended.

Any development that would endanger the existence of, or cause deterioration of the habitat from a 3 level in these marshes would be considered a major impact of that development on the wildlife resources of southern Ontario.

We do not know what effect radiation has on breeding populations of waterfowl. However SO2 fallout could affect important habitat of both resident and non-resident populations. At the public meeting on the twinning of Pickering, Hydro stated that fossil-fuelled reserve units, for the station already in operation, were operated for 400 to 500 hours per year. With twinning we might assume a total of 1000 hours per year. How much SO2 production this would amount to might be worth examining, especially considering that high quality (low sulphur content) fuels will probably be in short supply in future.

Figure 14 of Hydro's report shows proposed land development within two miles of the G.S. This includes some provision for wildlife "sanctuaries". However some of the intensive use picnic, park and sports areas associated may have various disturbing effects on wildlife in the areas e.g. noise, physical disturbance, pollution, habitat disturbance. This will depend, of course, on how much use is made of these developed areas. Urban wildlife management should allow areas to remain as undisturbed by human use as possible. People interested in wildlife specifically (for viewing and hunting) should have the opportunity to pursue their interests. However, creating intensive-use areas for other activities adjacent to a wildlife area would jeopardize this concept.

3.3 Fish

(a) Fisheries Resources

Ontario Hydro's Report says that water quality in Lake Ontario very strongly influences the character of the lake fisheries. A recent survey by the Ministy of Natural Reources (18), identifies local fishing and spawning sites. In the spring and fall, rainbow trout migrate up Duffin Creek, two miles east of the station site, to spawn. Spawning of other species such as coho salmon, are also thought to occur in the marshes and upper reaches of the Rouge River. The remainder of the spawning of local species probably occurs along the shoreline and in the main body of Lake Ontario (pages 81, 82).

Fish, such as rainbow trout and coho salmon, were stocked in the

lake recently. Both coho and rainbow trout are appearing in many of the streams between Oshawa and Toronto. In the spring of 1972, rainbow trout were stocked in the mid-sections of Duffin Creek (18) (page 82).

At present, fish such as yellow perch, sunfish, suckers, carp, catfish, alewife and smelt are the main species found in the area (page 82).

(b) Commercial Fishing

Ontario Hydro's Report says that in 1971 there was only one licensed commercial fisherman along this section of the shoreline. Catches consisted of smelt and alewife. In 20 miles of shoreline there are eight licensed commercial bait fishermen. In 1956-1970 commercial catch in pounds is given in Table 6.14 (18) (page 82).

(c) Fish Spawning and Migration

Ontario Hydro's Report says that the proposed station will be designed to have a low velocity thermal surface discharge. Thermal plume investigations at Pickering G.S. Units 1-4 (13) (sec 6.2.9) indicate that surface temperatures decrease to within 1F of ambient temperatures at approximately 10,000 ft. (2 miles) of the discharge outlet. Vertical temperature profiles indicate that the temperature at 20 feet was close to ambient in all areas outside of 2000 feet from the discharge. During periods of onshore wind the plumes will tend to follow the shoreline. The thermal discharges from the proposed Pickering G.S. Units 5-8 and Pickering G.S. Units 1-4 are not expected to overlap except in the surface layers (Figure 19). Since the thermal profile is much smaller at depth, and the plumes constantly move with shifts in winds and currents, the effect of the additional thermal plume is expected to have a very slight influence on the natural shoreline thermal regime (page 137).

As outlined in 6.2.7.1, known local spawning areas include Duffin Creek (2 miles east), Frenchman Bay (1 mile west) and the Rouge River (3 miles west). It is not expected that the thermal discharge will influence the temperatures at these points such that upstream migration is prevented. Existing data on fish intake however, indicate that some smelt and alewives are prevented from completing their spring migration. This loss of migrating fish is expected to be considerably reduced by the use of an offshore intake (page 137).

Some scouring and redistribution of the lake bottom sediments would be expected to occur in the near-shore discharge area. If the offshore intake results in a low silt intake it is predicted that rapid recolonization of the discharge area will occur after the bottom sediments are stabilized (page 138).

(d) Plankton

Ontario Hydro's Report says that for plankton not entrained in the condenser cooling water but influenced by the thermal discharge, there will be a localized shift at the warmer times of the year from a

diatom-dominated to a green algae-dominated population. The limitation of discharge temperatures to a maximum of 90F is not expected to cause significant pro- duction of blue-greem forms. This is substantiated by visual observations made during the last two years of on-site studies in the thermal discharge area (21, 107). It is not expected that algal blooms will be produced because the hydraulic momentum will limit the residence time of plankton in the area influenced by the thermal discharge (page 138).

(e) Filamentous Algae and Rooted Aquatic Plants

Ontario Hydro's Report says that observations in the thermal discharge area of other generating stations on Lake Ontario have revealed little or no obvious increase in the total algal biomass (37) (38) (39). At the Pickering site, both the growth and fragmentation period of the attached algae Cladophora, are expected to take place approximately one month earlier in the immediate discharge area. Growth may increase in those areas influenced by currents, but an increase in temperature is expected to have little or no effect. Temperatures favourable for growth in the discharge area during winter and spring will not lead to accumulation of attached algae as lower light levels and reduced day lengths become the limiting factors (39) (page 138).

(f) Entrainment of Organisms

Ontario Hydro's Report says that organisms entrained in the cooling system will include phytoplankton, zooplankton, the free-swimming larvae of benthic invertebrates, fish eggs and larvae, and young fish. They will be subjected to a maximum temperature rise of 19°F. In addition to temperature shock, there will be mechanical abrasion and pressure change effects (page 138).

Tests carried out at generating stations with once-through cooling system have shown that for temperatures below 94°F, little or no reduction in species composition of phytoplankton was observed (40, 41). Zooplankton passing through power station cooling systems showed no decrease in mortality when subjected to a maximum temperature of 88°F and a temperature rise of 18°F (42) (page 138).

Photosynthesis inhibition has been measured in phytoplankton when temperatures were raised from 73.4°F to 87.4°F (43). Some loss of mobility of zooplankton will occur but responses are variable (42,44). Small fish and various motile larval forms will not be able to move against the approach velocity at the intake and will therefore be drawn into the intake structures (page 138).

(g) Quality

Ontario Hydro's Report says that monitoring of water quality off the Pickering site has been carried out by various groups. Periodic surveys by the Great Lakes Institute (10), and water quality sampling in the Pickering area by the Ministry of the Environment have been combined with Ontario Hydro results to give a composite water quality analysis (Table 6.7) (page 67).

Since 1968, the Ministry of the Environment has monitored water quality at three stations near Pickering (65). Dissolved oxygen levels are normally high during the winter, but may decrease with depth to less saturated levels in the summer. Dissolved oxygen levels peak at approximately 14 ppm near the surface inshore in the spring, and gradually decrease to 7 ppm in the Frenchman Bay area in September. The lowest saturated level was 71% in Frenchman Bay in October at the 6-foot depth (21). This is well above a desirable lower limit of 5 ppm (97). Sampling in and outside the thermal plume area in 1971 and 1972 has not indicated any change in dissolved oxygen levels. (37, 107). Dissolved oxygen levels in the lake offshore from Pickering vary with season and depth from 9-14 ppm (4, 5, 6) (page 68).

Specific conductivity measurements in the inshore discharge area vary with season and average approximately 340 mho/cm-1. Offshore, specific conductivity varies with season, peaking at approximately 320 mho/cm-1 in the late fall lake turnover period and declining to 260 mho/cm-1 in the summer. Suspended solids are normally in the 25 ppm range. Strong winds cause turbulence which suspends silt, and readings of 150 ppm are not uncommon during these periods. Extremes of 700 ppm syspended solids have occurred during early winter storms (4, 5, 6) (page 68).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

Our concern for the environmental effects of large thermal plants using once-through cooling as a means of waste heat disposal has been expressed on numerous occasions (cf. MNR "Position Paper on Once-through Cooling"). We view with alarm the prospect of a proliferation of such plants on cold, deep, oligotrophic lakes such as Lake Ontario. The potential for damage to the aquatic ecosystem by surface, on-shore disposal of heat is very great in view of the importance of the littoral zone to lake productivity and the relatively restricted littoral areas possessed by these lakes. In listing alternatives to once-through cooling (Section 9.2) Hydro fails to mention several such alternatives, such as cooling towers or offshore, surface discharge. We wish to reiterate our position that Hydro be required to consider seriously the use of alternative methods of waste heat disposal at one or more sites, including Pickering.

With reference to the Introduction (p.1) of Hydro's environmental assessment, we fail to see how duplication of an existing station "...... will ensure minimal environmental effects". Information presently available does not allow us to predict at what level an increasing heat load will stress aquatic ecosystems to the point at which significant damage, and ultimately collapse, will occur. It is possible that duplication of an already large thermal plant is environmentally bad strategy. At this point we simply do not know.

We cannot agree that dissolved oxygen levels are not a cause for concern, as implied in Section 8.2.1.3 (p. 129). Levels in the Frenchman Bay area in September already decline to 7 ppm (p. 68), a level we feel is a more valid lower limit for coldwater fish then the 5 ppm cited. Addition of further heat to these waters may reduce oxygen solubility such that unacceptable levels of oxygen result.

Predicted thermal plumes (Fig. 19) may in fact be "typical" of seasonal conditions but do not illustrate extreme conditions which may be more damaging. For example, a strong south-westerly wind would tend to push heated water toward the shoreline to the east of the site. A sizable portion of the littoral zone could then be affected adversely. Since SW sinds occur in the area 17% of the time (Table 6.4), such effects are a very real possibility.

The effects of the heated effluent on fish living in or passing through the discharge area five cause for concern. There is evidence that some species, notably yellow perch, may be exposed to temperatures above their final preferenda (p. 131). Furthermore, Hydro's analysis of time-temperature exposures is based entirely on lethal effects (Table 8.4). The sublethal effects of long-term exposure to above ambient temperatures remain unknown. Such effects may be just as damaging to a population as are directly lethal ones.

There is little assurance that upstream migration of fishes will be unaffected by the thermal discharge (p.137). The potential for loss of reproduction due to premature spawning or failure to enter a stream mouth because of high temperatures requires considerably more study than it has been afforded here. The consequences of such effects at the Pickering site would be particularly serious because of the proximity of Duffin Creek, an extremely important migratory route for salmonid species and a stream on which the success of the Lake Ontario fisheries rehabilitation program depends.

Entrainment of fish at the existing plant has been a serious problem, particularly during the spring spawning season for smelt and alewives (Fig. 12). Hydro proposes to use an offshore intake with lower approach velocity to minimize this problem. The success of this technique and its applicability to other sites should be thoroughly evaluated.

3.4 Rivers

"River" as defined in The Lakes and Rivers Improvement Act, R.S.O. includes a creek and a stream.

Ontario Hydro's Report says that there is no local drainage system in this G.S. site. The surface run-offs and seepage encountered during construction will be taken care of by the artificial drainage system to be provided (page 116). All drainage will finally be discharged to the lake (page 141).

The fuel oil supply tanks will be dyked such that if either tank is breached the contents of the tank (plus 20%) will be contained and not overflow to the lake (page 140). Leaks from the fuel supply system feeding the generators will be collected and drained to a central underground storage tank (page 140).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

The Ministry of Natural Resources, in respect of its interests, agrees with the above proposals.

3.5 Recreation

Ontario Hydro's Report says that in addition to Darlington Provincial Park there are five conservation areas located within a 15-mile radius of the site. These are 1. Lower Rouge, 2. Greenwood, 3. Heber Down, 4. Claremont, 5. Harmony Valley. Two of these are within ten miles of the site, in addition to a few smaller municipal or privately- developed parks (page 101).

Within five miles of the site there are extensive recreational facilities, including the marinas and public parks on Frenchman Bay and smaller parks and picnic areas in Pickering Village and near the mouth of the Rouge River and Duffin Creek. There are relatively high densities of cottages at Squires Beach and Fairport Beach. Frenchman's Bay is the only natural harbour along the Metro waterfront east of Ashbridge's Bay (page 101).

The proposed future development of the Frenchman Bay area envisages:

(i) The bay shore including the sand spits for use by water- oriented recreational facilities, with the west shore for use by local residents.

(ii) Commercial marinas and public launching facilities confined to the eastern shore of the bay.

(iii) Retention of the marsh area at the head of the bay (page 103).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

The Ministry of Natural Resources has a major responsibility to provide recreational opportunities in accordance with its terms of reference. Subject to the matters discussed elsewhere in this report in respect to forests and plants, fish and wildlife, air, water and land quality, the Ministry does not foresee that the Pickering G.S. proposal will have an intolerable impact as to recreation.

3.6 Land (above and underwater and dredging, filling and dumping)

Ontario Hydro's report says that the site of the proposed station has similar topography to that of the existing station. The site is presently occupied by construction and training facilities which could be moved to permit grading and clearing. The shoreline would be extended into the lake using excavated materials in a manner similar to that for the existing station. The main impact on the site area would be the excavation, mainly of bedrock, required to provide the structural foundations and cooling water passages. Excavation will lower ground water levels in the immediate area of the powerhouse. Ground water levels elsewhere on the site should not be affected (page 6).

No new property is required for the construction of the proposed station (page 6).

The Pickering site occupies a land area of about 500 acres in the township of Pickering. The total frontage along the shorelines of Lake Ontario is about 8,000 feet (page 17).

The proposed station will be located to the east and immediately adjacent to the existing four units (page 17).

Ontario Hydro has set aside an area within the exclusion radius for the Pickering site as a public park and wild life sanctuary and now utilizes the services of the Metropolitan Toronto and Region Conservation Authority to maintain control of this park and wild life area. This area is at the western side of the property and includes the marsh which is to be preserved in its natural state (page 32).

The existing 500-foot wide Hydro owned egress has two, 230 kv two circuit lines constructed, on each side of the egress path, with provision for two 230 kv double circuit lines to go in between (page 51).

No new acquisition of property will be required. The line agress will be on Ontario Hydro owned land (page 51).

The property is zoned industrial and no further formal application need by submitted to the local planning boards (page 51).

On the Ontario Hydro property two miles north of the present station is the site of an Indian village. Archaelogical work on this site will not be affected by the proposed station extension (page 94).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

(a) Land (excluding water lots)

The proposed site is patented land and is in an area containing residential, commercial, light and some heavy industrial development, farming and recreational development. For the Ministry of Natural Resources comments in respect to recreation please refer to our 3.5 above.

Ontario Hydro is negotiating with the Ministry of Natural Resources for the production of O.L.A. stock for landscaping and screening purposes.

(b) Water Lots

Ontario Hydro's Report says that the reclamation of land for the powerhouse area (Section 7.2.3 Ontario Hydro) will absorb some of the excavated soil materials. Various areas on site for disposal of the remaining excavated material are being reviewed. Lake dumping of material, therefore, should not be extensive and should only adversely affect existing water quality of any fishing or spawning areas in the localized area. The proposed cooling water intake structures for the proposed station are described in Section 8 (Ontario Hydro). Dredgings from the condenser cooling water discharge channel area will be dumped in a lake location chosen for its

minimal effect on water quality and aquatic life. During dumping some suspension of silt will occur within 1000 feet and have some slight detrimental effects on aquatic life. An investigation at Lennox G.S. (113) reviews the results of turbidity monitoring during a similar operation. Measurements indicate a local, short-lived suspension of dumped material. From this study it is concluded that lake dumping of dredged material in a controlled manner, will cause turbid conditions for a matter of a few hours after dumping within the immediate vicinity only. Release of nutrients to the water from the dredged material is predicted to be very small (133) (page 115).

Permission was received from the Department of Transport to install two 1,000-foot rock-filled groins to be built out from the present intake channel. These groins are approximately 300 feet apart. This structure will aid in prevention of silt and week intake into the station and would restrict thermal recirculation. Their effect will be studies with a view to decisions required for the intake structure for an 8-Unit station. It is expected that construction of the 1000-foot groins will be completed by the end of 1973 (page 81).

Dredging, excavation and dumping during construction of the condenser cooling water discharge channel and the proposed offshore intake, will produce some suspended matter and dissolved nutrient materials in the waters adjacent to the operation. As discussed in 7.2.1 by Ontario Hydro, the impact of this operation was assessed at the Lennox site and the results indicate that no effects were observed (113). The Pickering site area is less biologically active than at Lennox so effects are predicted to be very small (page 115).

The ground water level in the site area is generally high. In the area of the proposed excavation for the powerhouse yard, the ground water is located at about El. 260. Some form of dewatering system will be required to lower the water level to below excavation level to ensure that construction is in the dry. It is not expected that the ground water level within the excavation will be lowered more than 20 feet, so significant effect of ground water lowering will not be felt outside the site boundaries which are at least 3,000 feet away. The water level in the wet marsh on the far west side of the property should not be affected due to its distance from the excavation (page 116).

COMMENT BY THE MINISTRY OF NATURAL RESOURCES

(b) Water Lots

Ontario Hydro has applied to the Ministry of Natural Resources for an additional water lot outside of its existing patented waterlot of about 146 acres. The existing waterlot is HY-76 patented Aug. 6, 1968, reference no. 133578. The new water lot applied for is designated as HY-145 and is 2100 feet by 1300 feet being about 62 acres. The application for the new water lot is presumably to cover the construction of two groins extending 1000 feet into Lake Ontario of which 900 feet was completed by the end of December 1973, we understand. The Ministry of the Environment (G.A. Pearce memo

to R.D. Wardell of Ontario Hydro dated May 28, 1973) is concerned as to the likely effect these groins will have on the littoral drift. The water quality of Frenchman Bay is dependent on the limited periodic exchange taking place at the entrance to Frenchman's Bay and it is important that these natural processes are maintained. Ontario Hydro has advised, we understand, the Metro Toronto and Region Conservation Authority (MTRCA) and the Ministry of the Environment, that the groins may be temporary and that an intake tunnel may have to replace the groins which would be removed. MTRCA is concerened that the groins will be a barrier to small boat traffic, we understand. However, it is our understanding that the Canada Department of Transport has given permission to Ontario Hydro for the construction of the groins under The Navigable Waters Protection Act.

Disposal of dredgings in the lake is under the provisions of The Navigable Waters Protection Act. The Department of transport (Canada) refers an application to the Ontario Ministries of Environment and Natural Resources for their comment as to any adverse environmental impact. These two Ministries provide an assessment to the Dept. of Transport before a license to dredge and dump is issued (page 45). The actual fact is that the Federal Dept. of Transport does not seem to have referred Ontario Hydro's application for a license to dredge and dump to the Ministry of Natural Resources requesting the Ministry to determine if dumping will have an adverse environmental impact. The Ministry has concerns which agree with those of the Ministry of Environment - see page 27 herein. It is pointed out in the case of Ontario Hydro's water lot application to this Ministry re the proposed Bowmanville G.S. that the Ministry of Natural Resources has requested the submission of an environmental assessment before further consideration is given to that application - see letter from the Director, Lands Administration Branch of Dec. 17, 1973 to Mr. W.J. West of Ontario Hydro.

March 1, 1974

Mr. J.W. Giles,
Assistant Deputy Minister -
Lands and Waters,
Ministry of Natural Resources,
Policy Research Branch,
Whitney Block,
Queen's Park,
TORONTO, Ontario.

File: NK30-0000P

Dear Sir:

Proposed Generating Station for Pickering

This is further to our submission to you on November 13, 1973 of our Proposal for the Pickering Generating Station, and your memo dated January 23, 1974.

1.0 Long-term Lake Effects of Shoreline Thermal Discharges

H2 Section 2

Ontario Hydro notes the Ministry's prediction that "a very large percentage of the littoral zone will be placed under stress and that the entire lake ecosystems will be damaged," if waste heat is discharged at the shoreline from a series of stations along the lakeshore. We repeat our comment made in our letter to the Honorable Leo Bernier, dated January 16, 1974, on the Wesleyville project, that your Ministry has joined with the Ministry of the Environment, Ontario Hydro has representatives of the federal government in a task force to study the effects of cooling water discharges on the aquatic ecosystems. Research programs developed by this task force would presumably be designed with your concerns in mind.

2.0 Page 3, Section 3.1(a), Pages 11-12, Section 3.2

Ontario Hydro will conform to the air quality standards for sulphur dioxide impingements and other gaseous emissions established by the Ministry of the Environment. Infrequent use, in addition to the operating requirement for gas turbines

to use low sulphur fuel (maximum 0.7% sulphur), will ensure very low sulphur dioxide emissions from the site area.

3.0 Page 5, Section 3.1

The design targets for operation of the proposed station will ensure that dose rate levels due to radioactive emissions to inhabitants living on the site boundary will be well within the federal government regulations. We are, therefore, confident that effects of emissions on plants, fish and other wildlife within the area will be insignificant.

4.0 Page 8, Section 3.2

The construction and operation of the proposed station will not affect existing marshes near the site. The marshes located within the exclusion area to the west of the existing station are under the supervision of the MTRCA. Details of the marsh area were discussed extensively with the Pickering Environmental Advisory Committee prior to Ontario Hydro giving supervision of the marsh area to MTRCA.

5.0 Pages 16-17, Section 3.3

Ontario Hydro is continuing its investigations of alternative once-through cooling methods and alternative means of once-through cooling water dispersal.

The introductory statement which lead the Ministry to state that Ontario Hydro claims duplication of the existing station"....will ensure minimal effects," has perhaps been misunderstood. Our statement is intended to indicate that we will be in a better position to predict and minimize effects of the proposed station following experience with the first station. This has already proven correct with regard to the need for design improvements for suspended silt and algae, heat recirculation and fish intake.

6.0 Page 19, Section 3.3

Low levels of dissolved oxygen have been recorded in Frenchman Bay in years prior to full operation of the existing station. Our on-site and physical modelling studies have not shown any

indication of the thermal discharge from the existing station influencing temperatures in the Bay.

7.0 Pages 19-20, Section 3.3

Our analysis of the tolerance of fish to elevated temperatures in the discharge includes an extrapolation to a time of 10-4 minutes (approximately one week) so we do not see that only short term exposures are considered. Very recent data at the site supplied by the CCIW supports our documented information that fish residence in the area affected by the thermal discharge is generally much less than this period. With this information, therefore, we feel that sub-lethal effects appear to be an unlikely occurrence.

8.0 Page 20, Section 3.3

In 1974, Ontario Hydro proposes to study the influence of the existing thermal discharge on the migration of fish by measuring populations of migrants in the thermal discharge area.

There is daily record of fish intake to the existing plant which will allow us to evaluate the effectiveness of the groins compared with the submerged intake at Nanticoke G.S.

9.0 Page 26, Water Lots

Ontario Hydro completed the first 1,000 feet of groins at the end of December 1973. Also, Ontario Hydro has approval, under the Navigable Waters Protection Act, to construct a further 1,000 feet of groins. It should be noted that the new water lot applied for is for this additional 1,000 feet of groins.

Further discussions will be held with the appropriate Ministries before any further groin construction beyond the existing 1,000 feet commences.

We believe we have satisfied the Ministry of the Environment's concerns regarding the installation of the subject groins and for your information we are attaching hereto our letters to the Ministry of the Environment dated June 19, 1973 and July 13, 1973, and their reply dated July 9, 1973. It should also be

noted that the information sent to the Ministry of the Environment was also sent to the MTRCA.

We trust you will find this satisfactorily covers your concerns.

As you are probably aware, we are hopeful that government approval for the Pickering "B" project will be received in time to start construction on May 1, 1974. To this end, we would appreciate your approval of this project, even if it is provisional, subject to additional information being provided at a later date on areas of mutual concern.

Yours truly,

W.G. Morrison
Assistant Director
Generation Projects Division

JMcC:jk

Enc.

cc: Messrs. H.A. Jackson
A. Hill
J. McCredie
W.R. Effer
J.B. Bryce

July 13, 1973

The Ministry of the Environment,
40 St. Clair Avenue West,
TORONTO, Ontario.

R.D. Wardell

File: NA44-00501P

Attention: Mr. G.A. Pearce, Program Engineer
Water Quality Branch

Dear Sirs:

Pickering G.S.
Construction of Intake Groins

We have obtained, by hand, a copy of your letter of July 9, 1973: the original may possibly have gone astray in the mail since we have not received it as of this date.

We have made arrangements to expand our current water sampling program in Frenchman Bay as specified in your letter.

We have already established, for modelling purposes, control points across the bar between the Bay and the Lake in March of this year and have plotted subaqueous contours from the shoreline out into the Lake, based on survey lines at 120 foot intervals across the bar. We, therefore, propose to profile on these same lines periodically prior to and after construction is underway.

Water quality data and survey results will be forwarded to you as they become available.

We note that you have no further comments on this project and trust these programs will be found to comply with the intent of your requests.

We shall now proceed to award a contract for the first 2,000 feet of groins and wish to thank you very much for your attention in this matter.

Yours truly,

R.D. Wardell
Manager of Engineering
Pickering G.S.

RDW;jk
cc: Messrs. H.A. Jackson, W.G. Morison, J.B. Bryce, V.A. Harrison, A. Hill, R.C. Paul, W.R. Effer, A.W.M. Kirkpatrick

July 9, 1973

Mr. R.D. Wardell
Manager of Engineering
Pickering Generating Station
Ontario Hydro
620 University Avenue
TORONTO 2, Ontario

Dear Sir:

RE Pickering Generating Station Intake Groins

We have reviewed the data which you forwarded on June 19 in response to the discussions held at our office on June 11.

The water quality data which you provided indicates that no degradation in Frenchman's Bay has been detected since sampling commenced in September 1970. We request that this monitoring be expanded to enable earlier detection of changes which could be brought about by the groin construction specifically monthly sampling at least from April to October should be insulated at three stations in the bay, just inside of the harbour entrance, and the north and east ends of the bay. The analyses should include dissolved oxygen, nutrients, socchl disc, chicrophyll A and pH.

Unfortunately, none of the data requested on littoral drift was provided. The configuration of the harbour mouth indicates that some drift to the west occurs. Rock groins extending more than 1,000 feet into the lake will definitely interrupt the drift pattern. To ensure that any physical effects of such on interruption can be detected in sufficient time to take remedial action, we request that a baseline be established across the bar between the bay and the lake. The shoreline should then be profiled in advance of constructing the groins and periodically (say quarterly) after construction is underway.

Please submit water quality monitoring data and survey results to the undersigned as they become available.

Provided the above requests are compiled with, this office has no further comments on the project.

Please involve us at an earlier date for construction of the intake tunnel to allow sufficient time to examine the environmental implications.

Yours very truly,

WDW:vh

G.A. Pearce, Program Engineer
Water Quality Branch

cc: Mr. C.A. Marglean - Canada Dept. of Transport
Mr. L. Schel - Ministry of Natural Resources
Mr. C. Young - Environment Canada (Kingston)
Mr. G.A. Missingham
Mr. D. Veal
Mr. S.E. Salbach
Dr. M.D. Palmer
Mr. W.D. Wilkins

June 19, 1973

Mr. G.A. Pearce,
Program Engineer,
Water Quality Branch,
Ministry of the Environment,
135 St. Clair Avenue West,
Suite 400,
TORONTO, Ontario.

R.D. Wardell

File: NA44-23000P

Dear Sir:

Pickering G.S. Units 1-4
Construction of Intake Groins

This is further to your letter dated May 28, 1973, on the above mentioned subject.

As you are aware, our Messrs. J.B. Bryce and J. McCredie met with your Messrs. M.D. Palmer and W.D. Wilkins to discuss, in general terms, your concerns regarding the installation of the intake groins. Based on this discussion, we have compiled the following information which we trust will allow you to proceed with the necessary approval.

Water Quality - Frenchman Bay

With regard to your request for evidence that groin construction will not affect water quality in Frenchman Bay, we are attaching a summary table of results covering the period September 1970 - November 1972.

The results to date indicate that:

(a) Temperatures increase much more rapidly during the period May-June then in the open lake and reach a maximum which is approximately 2-5C higher than the lake. This peak temperature appears to occur in July in the Bay and slightly later in the Lake.

(b) Dissolved oxygen levels in both the Bay and Lake are close to saturation levels in the period April-November.

(c) Nutrients, as indicated by phosphate and nitrate, indicate levels to be approximately 3-5 times higher than the levels found in local in-shore waters by the CCIW and IJC.

(d) Water in the Bay is approximately four times more turbid than in the Lake proper.

These results suggest that the waters in Frenchman Bay are enriched in nutrients from local sources and, based on the turbidity, are highly productive. This high productivity does not as yet cause bottom waters to become oxygen-deficient, which may be mainly due to the shallowness in the Bay.

Water temperatures and other water quality parameters do not indicate any change in the Bay during this period of investigation.

Investigation of Nearshore Lake Currents

To acquire the necessary field data for hydraulic and thermal modelling, of that portion of Lake Ontario extending to about one mile offshore from the Pickering Generating Station, eight in-situ currents recorders were installed and records obtained for approximately two months, from mid-March to mid-May, 1973. The locations of the recorders, select to suit modelling requirements, are shown on Plate 1, on which are also indicated the depths of water, the depths of recorders, and the period of record.

Preliminary analyses of hourly current records for the two-month period revealed fifteen separate periods varying from 32 to 168 hours in duration, when directionwise the flow was steady at all recorders. These steady periods were interspaced with periods, in duration from one hour to several days, when the current direction was changing. The fifteen steady periods represent 72% of the total recording time.

(a) In six of these steady periods, representing 28% of the total time, the currents were in a westerly direction approximately parallel to the shoreline, and they were associated with ENE and NE winds. These are illustrated on Plate 2.

(b) Another six periods representing 31% of the total time were with steady flow in an easterly direction, again approximately parallel to the shoreline. During these periods, winds was generally from NW-W-SW quadrant. (Plate 3).

(c) In the remaining periods, comprising 12% of the total recording time, NE and NNE (inshore) currents at centrally located recorders M-4 and M-15, were associated with offshore winds, as shown on Plate 4. However, at the locations on the East and West (9-1E, A-0 and M-25, N-25) the currents turned parallel to the shorelines.

Current speed varied from 0.1 to 1.0 ft./sec.; stronger currents being recorded during the periods of high wind.

At the locations M-15 and G-1E, two recorders were installed at different depths: 17 feet and 37 feet at M-15; and 17 feet and 32 feet at G-1E. The records showed identical direction at both shallower and deeper recorders; the current speed, however, was slower at the deeper recorders.

From these current observations during a limited time period, it would appear that no prevailing current or drift exists in this portion of the shoreline. The observations indicated that the current flows about equally east and west along the shoreline, depending largely upon the wind direction.

Further current measurements will be made in the Lake offshore from Frenchman Bay, including observations of the flow interchange between the Lake and the Bay.

In addition to the information presented above, a hydraulic model is under construction as part of an overall test program for the Pickering G.S. Units 1 to 4 and the proposed Units 5-8, with the first test date scheduled to be available during the second half of 1973. Arrangements will be made to include the intake groins as part of this overall model test program.

We are also attaching hereto as requested, one copy of the tendering document (No. C-3605-73) for the subject groins.

We have scheduled to complete at least 1,000 feet of this groin this year and as such, we would appreciate your early attention to this matter.

Yours truly,

R.D. Wardell
Manager of Engineering
Pickering G.S.

JMcC;jk

Enc.

cc: Messrs. H.A. Jackson
W.G. Morison
J.B. Bryce
A. Hill
J. McCredie
R.C. Paul
W.R. Effer

ONTARIO HYDRO
500KV TRANSMISSION LINE RIGHT-OF-WAY
LENNOX-OSHAWA
ENVIRONMENTAL REPORT

ERRATA

p 8 - figure 2B - lines east of Switching Station A should be solid

p 36 - left - line 3 - Change "location" to "locations"

p 54 - delete lines 4 & 5 second paragraph and replace with:
"...the most easterly section where the most northerly Corridor C' was preferred with Corridor A/B a close second."

p 169 - left - line 14 - Change "The maximum clearances" to "The minimum clearances"

p 232 - left - line 5 should read: "A. URBAN - Land used for urban and associated nonagricultural purposes."

p 236 - left - line 15 - should read: "Class 7 - $>$ 60% Slope"

p 237 - right - line 4 - the formula should read:

$$ASC = \frac{((AA \times AB) + (AC \times AD))}{(AB + AD)}$$

p 240-241 - Table 1 - Agriculture (Acres)
Darlington through Murray Township
All numbers should be lowered one space

p 242-271 - A number of the figures on these pages are incorrect. Replacement pages are enclosed.

May 16, 1974